SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST 1909.

GENERAL PHYSICS.

1348. *Landgraf-Turner Alternating Impact Machine.* (Iron and Steel Times, 1. pp. 340–343, June 24, 1909.)—This machine is designed to carry out Arnold's test, in which the specimen is stressed beyond the elastic limit by alternate bending. A cylindrical test-piece, 8 in. long by ⅜ in. diam., is firmly clamped at the bottom for 1½ in. of its length in a vice, while the top of the test-piece passes between two tool-steel hammer dies ¾ in. apart, contained in a rocker arm whose function is to deflect the specimen from side to side by its motion. The space between the dies causes the specimen to be free during each stroke, and in this way a blow is given to the specimen at each alternation. The "free length of the specimen" is 4 in. and the stroke of the arm 1⅜ in., so that the specimen is deflected ⅜ in. on each side of its mean position. A Veeder counter is brought into gear with the crank-shaft by means of a lever connected to the upper end of the test-piece by means of a spring. When the specimen breaks, the tension in the spring is relaxed and the counter thrown out of action. For brittle materials a less drastic test is obtained by using dies with a larger slot, thus giving a smaller deflection. A "quality figure" $= ERA/10^6$, where $E =$ elastic limit, $R =$ reduction of area, and $A =$ alternations endured, has been evolved for use in conjunction with this machine. F. C. A. H. L.

1349. *Torsion of Rectangular Bars.* **R. Goetzke.** (Zeitschr. Vereines Deutsch. Ing. 53. pp. 935–940, June 12, 1909.)—Gives an outline of the mathematical theory of the torsion of bars of rectangular section, and selects the following approximate formulæ: $T_{\text{max.}} = 2cGa\phi(b/a)$ and $M = (16/3)cGa^2b\psi(b/a)$. $T_{\text{max.}}$ is the greatest shear stress, M is the torsional moment, b is half the longer and a half the shorter side of the section, c is the angle of torsion per unit of length, G the modulus of rigidity, and $\phi(b/a)$ and $\psi(b/a)$ are tabulated. F. R.

1350. *Demonstration of Elastic Shock.* **W. Westphal.** (Deutsch. Phys. Gesell., Verh. 11. 11. pp. 273–274, June 15, 1909. Communication from the Physikal. Inst. d. Univ., Berlin.)—The author recommends the use of steel bearing balls in place of ivory in the usual pendulum apparatus for demonstrating elastic rebound. The following comparative results are given :—

	Steel.		Glass.	Ivory.	
Radius of ball, cm.	1·85	2·20	2·65	1·85	2·5
Loss of energy in one blow, per cent.	0·52	1·30	8·84	6·60	6·70

F. R.

1351. *Properties of Refractory Materials.* **S. Wologdine.** (Bull. Soc. d'Encouragement, 111. pp. 879–942, May, 1909.)—A lengthy table of results is given of the conductivity for heat, porosity, and permeability (to gases) of numerous refractory materials. Many of these are of ceramic interest only, and given by name without composition ; but a few results are selected in the following table. Analyses are given in certain cases. The types dealt with are mixtures for refractory products, service, bricks, and terra-cotta. With exceptions there is a roughly inverse relation between porosity and conductivity.

Material.	Baking Temperature.	Density.		Porosity per cent. of Volume.	Conductivity.		Permeability.	
		Real.	Apparent.		Gm.-cals. per sec. per cm.² per cm. thick per 1° temp.-difference.	Gm.-cals. per hour per m.² per m. per deg.	Cm.³ per sec. per cm.² per cm. thick.	Litres per hour per m.² per m. thick.
Ordinary fireclays	1,050°–1,300°	2·5–2·61	1·78–1·9	24·1–30·8	0·0030–0·0050	1·08–1·81	0·015–0·295	5·58–106·2
Bauxite	1,050° 1,300°	3·22 3·12	1·89 1·92	41·5 38·4	0·0031 0·0033	1·11 1·19	0·0292 0·212	10·50 76·39
Silica	1,050° 1,300°	2·75 2·62	1·58 1·50	42·58 42·9	0·0020 0·0031	0·71 1·12	0·0092 0·536	3·32 192·9
Magnesia	1,050° 1,300°	3·07 3·39	2·0 2·0	35·1 41·0	0·0058 0·0065	2·08 2·35	0·517 0·0097	186·1 3·49
Carborundum	1,050° 1,300°	— —	— —	— —	0·0145 0·0231	5·28 8·32	— —	— —
Kieselguhr	—	2·48	1·08	58·0	0·0018	0·64	0·0957	34·45
China	1,050°–1,400°	2·36–2·57	1·91–2·18	9·59–25·5	0·0031–0·0049	1·10–1·78	0–0·0047	0–1·68
Building bricks	1,050°	2·48–2·56	1·26–1·90	19·9–25·1	0·0033–0·0037	1·20–1·34	0·0015	0·53
Terra-cotta bricks	1,050°	2·54	1·95	23·0	0·0028–0·0035	1·01–1·26	0·0021	0·74

F. R.

1352. *Plant used in the Manufacture of Tubes.* **W. H. A. Robertson.** (Journ. Inst. of Metals, 1. pp. 268–277, 1909. Mech. Eng. 24. pp. 12–14, July 2, 1909.)—Gives an account of the manufacture of solid-drawn tubes, which is divided into two parts: (1) The production of the shell; (2) drawing the shell to finished size. In manufacture, the shell is delivered to the draw-benches as near as possible to the size of the finished tube consistent with the amount of work which has to be done on the material in order to obtain the requisite tests and smoothness of surface. The shell must be perfectly concentric, as any eccentricity becomes exaggerated in the cold drawing; the surface must be quite smooth, as defects will draw out, and the inside of the shell must be quite free from flaws. The more general methods of producing the shell are described: Drilling and rolling; casting; Mannesman process; punching process; Elmore's process; centrifugal process; and extrusion process. The methods of drawing the shell to the finished size on chain-drawn draw-benches and on hydraulic draw-benches are given with some detail, as it is considered that the subject has been somewhat neglected. On chain-driven benches the chains are now universally made of high-carbon steel having a tensile stress of not less than 60 tons per sq. in. The dies are made of special die steel. A special form of hydraulic bench used for drawing large short tubes is described. Shouldering machines, saws, and tube-boring machines are also briefly described. The following formula is given for approximately determining the power required to drive draw-benches: $HP = T \times A \times S \times \phi/33000$, where T is breaking stress in lbs. per sq. in., A = area in sq. in., S = speed of chain in ft. per min., and ϕ is a variable coefficient depending upon the size of the bench and gearing. The efficiency of a double-geared bench may be approximately 65 per cent., and of a single-geared bench 75 per cent. With regard to the speed of drawing, this will vary considerably with the material, but the following speeds represent up-to-date practice: Tubes up to $\frac{3}{4}$ in. and 16 gauge, 120 ft. per min.; $\frac{3}{4}$ in. to 1 in. and 14 g., 100 ft.; 1 in. to 1$\frac{1}{4}$ in. and 12 g., 70 ft.; 1$\frac{1}{4}$ in. to 2 in. and 10 g., 60 ft. per min. For breaking down and intermediate reductions it is not advisable to run at more than 50 ft. per min., and for large shells above 4 in. diam. by $\frac{3}{8}$ in. thick 20 ft. per min. is a fair speed.

C. O. B.

1353. *Turbulent Liquid Viscosity.* **E. Bose** and **D. Rauert.** (Phys. Zeitschr. 10. pp. 406–409, June 15, 1909.)—An experimental test of the formula of Osborne-Reynolds, which is here written—

$$\log_e (1/z) = a + b \log_e (dP/dx),$$

or, in words, the log. of the reciprocal of the time (z) of outflow is a linear function of the log. of the mean pressure-gradient. Water, ethyl alcohol, ethyl acetate, benzol, toluol, acetone, chloroform, bromoform, and mercury are investigated, the results being contained in 9 tables showing that the above formula is not quite an exact expression of the facts of the case.

E. H. B.

1354. *On Pitot-tube Measurements of the Velocity of Water.* **K. Ellon.** (Zeitschr. Vereines Deutsch. Ing. 53. pp. 989–998, June 19, 1909.)—The theory of the Pitot tube is considered, and several forms of nozzle are described which may be used in experimental work on the velocity of flowing water. One great difficulty in the measurement is that the column of water in the tube is small, particularly if the velocity is small. This may be overcome by having the tube in communication with a lifting apparatus connected to an air-pump, so that the rise of the water in the vertical tube is magnified.

Working on a low-pressure water turbine, the author has made some experiments, using a double-nozzle Pitot tube, from the results of which he concludes: (1) That a nozzle gives the correct current velocity only when the stream-lines are parallel and the nozzle is accurately in the direction of the stream; (2) that if the nozzle be rotated out of the direction of the stream, the component velocity can only be obtained if the angle of rotation is known.

W. C. S. P.

1355. *Nucleation of a Close Lecture-room.* **Miss L. C. Brant.** (Science, 29. pp. 796–797, May 14, 1909.)—Note on an experiment performed with air from a room in which 100 students were present during an hour. The air was aspirated continuously through a fog-chamber and examined by exhaustion from time to time. During the hour, until the end, nucleation diminished. There appears to be no appreciable evolution of non-gaseous matter, but rather an absorption of nuclei by the respiration of a hundred human beings, even when the closeness of the air becomes oppressive.

J. J. S.

1356. *Constitution of Atoms.* **B. de Szyszkowski.** (Nature, 80. p. 276, May 6, 1909.)—Morozoff's theory (1908) accounts for the fact that no chemical particle liberated in radio-active charges carries less than two elementary electric charges. All elements are combinations of three primitive elements called archonium (Z); protohelium (x); and protohydrogen (h), which have combining weights 4, 2, and 1 respectively. Radium is represented by the symbol $x - Z(x_2h) - [Z(xh)_6]_6 - (x_2h)Z - x$. Radio-activity is due to the closing of the chain and the discharge of two helium half-atoms x, which yield the material carriers of electricity of the α-particles. Hence a whole atom carries at least two elementary charges. Generally, in all radio-active charges, the smallest quantity of electricity associated with an atom of matter is not an atom ($4{\cdot}65 \times 10^{-10}$), but a molecule of electricity ($9{\cdot}3 \times 10^{-10}$).

E. E. F.

1357. *Wind Records for Berlin.* **V. Kremser.** (Meteorolog. Zeitschr. 26. pp. 259–265, June, 1909.)—An anemometer was maintained on the tower of the Joachimsthal "Gymnasium" from 1884 to 1908. The paper gives the monthly means of wind velocity for each year of this period, and also the hourly means for each month for each of the 10-year periods. The records are mainly interesting as showing the influence of the spreading of the tower on the exposure. The anemometer was fixed 1·7 m. above the parapet of the tower, which is 32 m. above the ground and 15 to 20 m. above the general level of the roof. In 1884 the building was in open country; at the end of the period (1908) it was surrounded on all sides by buildings of average height 22 to 25 m. The effective height of the anemometer aboveground was thus reduced by this amount. The mean velocities (in m. per sec.) for successive lustra were as follows: 1884–88, 5·44; 1889–93, 4·80; 1894–98, 4·04; 1899–1903, 3·82.

R. G. K. L.

1358. *Atmospheric Temperature at the Summit of Monte Rosa and at Alagna.* **C. Alessandri and F. Eredia.** (Accad. Lincei, Atti, 18. pp. 601–605, June 6, 1909.)—The average hourly temperature during the complete 24 hours is given for periods of 10 days throughout July, Aug., and Sept., 1907 and 1908. At Monte Rosa the highest temperatures occur between 12h. and 16h. in the third decade of July, and at Alagna between 12h. and 14h. in the second and third decades of Aug. The coldest time at both places coincides, being about 5h. in the third decade of Aug. and in the first decade of Sept. The monthly averages at Monte Rosa agree well with the values calculated by Oddone [Abstract No. 1617 (1904)], but the mean average for the three months is −5·95°, as compared with −6·2°, calculated for the open air at a similar height. W. H. St.

1359. *Meteorological Observations at Timbuktu in* 1905 *and* 1906. **J. Hann.** (Meteorolog. Zeitschr. 26. pp. 281–282, June, 1909.)—Analyses of observations taken at 7 a.m., 1 p.m., and 9 p.m., published in the Annales du Bureau Central Météorolog. de France. The diurnal temperature amplitude varied from 12·6° to 19·5° C. as the monthly mean; the annual rainfall was 231 and 259 mm. in the two years; in 1905 most of the rain fell in July to Sept., and these three months had also the greatest number of thunderstorms, 12, 13, 11 of a total of 44. H. B.

1360. *The Earthquake of the Gulf of Corinth of May* 30, 1909. **D. Eginitis.** (Comptes Rendus, 148. pp. 1799–1800, June 28, 1909.)—The earthquake was felt all over Greece, and recorded at Athens, Ægion, and Zante. At Athens the principal phase set in 20 sec. after the preliminary tremor. The formula of Omori would give a distance of the epicentre of 145 km.; the phases would not be distinguished at Ægion), and the general phenomena point to an epicentre north-west of Ægion, on the coast of Doris, 150 km. from Athens. The preliminary tremor seems to have travelled at a velocity of 5 km., the principal phase at 8 km. H. B.

1361. *Position of Sun's Axis of Rotation.* **H. H. Turner.** (Roy. Astronom. Soc., Monthly Notices, 69. pp. 487–490, April, 1909.)—Discussion of the sun-spot observations made by C. H. F. Peters at Clinton, New York, during the period 1860–1870, with a 13-in. refractor. These are arranged to show daily drift in latitude for each month, and the groups for latitudes of 20° and under are analysed harmonically to determine the error of position of the pole of rotation. Evidence is shown that a discordance exists between the results given by spots in northern and southern hemisphere, so that a different position of pole is indicated according as the spots preponderate in one hemisphere or the other. C. P. B.

1362. *Changes in Form and Size of Solar Disc.* **F. R. Moulton.** (Astrophys. Journ. 29. pp. 257–280, May, 1909.)—Discussion of the shape of the sun, assuming that it is in a state of equilibrium of rotation, and some of the consequences of its possible oscillations. On the hypothesis that it is rotating without oscillations, it is found that the form must be nearly an oblate spheroid, the difference between the equatorial and polar diameters being less than 0″·7 as seen from the earth. From other considerations, however, it is to be expected that such a mass as the sun may undergo oscillations whose amplitude and character will depend on the nature of the disturbances producing them, with periods affected by the mass, density, and elasticity of the solar medium. From an analysis of the effect of a dilational oscillation on the rate of rotation it is determined that the shrinkage of diam. by 1″·0, as seen from the earth, would only decrease the period by 88 min. Assuming Stefan's law of radiation, the temperature of the sun at mean radius is found to be 6,000° C. (abs.), and, taking maximum value of oscillation, we should expect a change corresponding to about one stellar magnitude. In fact, an extreme oscillation of 0″·01 in the sun's diam. would account for the 10 per cent. variations of solar radiation recorded by Langley and Abbot. The author then examines this view by means of zonal harmonics of the second order, and comparisons with results obtained by Kelvin and Lamb are given. Additional references are made to the possibility of extending the same theory to certain types of variable stars, such as δ Cephei and β Lyræ. C. P. B.

1363. *Temperature of the Sun.* **G. Millochau.** (Journ. de Physique, 8. pp. 347–360, May, 1909. Paper read before the Soc. franç. de Physique, Jan. 15, 1909.)—The author has in a former note [Abstract No. 1311 (1907)] given the results of preliminary work on the summit of Mont Blanc. Further comparisons with a special actinometer have been made, indicating a solar temperature from 5,696° to 5,567° C. (abs.). The coefficient of absorption on Mont Blanc appears to be constant and equal to 0·084. C. P. B.

1364. *Solar Constant and Temperature of Sun.* **C. Féry.** (Roy. Astronom. Soc., Monthly Notices, 69. pp. 611–614, May, 1909.)—By means of a gilded mirror of 1 m. focal length, a solar image 8 mm. diam. is projected on a thermo-couple of 0·5 mm. diam., which had been calibrated by means of an electric arc standard. From more than 700 observations made by Millochau at various altitudes between Meudon and Mont Blanc, the coefficient of zenithal transmission at Mont Blanc has been fixed at 0·91. The temperature at the centre of the sun's disc was thus determined to be 5,550° C. (abs.), and the mean temperature 5,360°. This would indicate that the accepted value 2·4 for the solar constant is somewhat too high. C. P. B.

1365. *Improvements in Solar Constant Determinations.* **C. G. Abbot** and **F. E. Fowle, Jr.** (Astrophys. Journ. 29. pp. 281–289, May, 1909.)—Certain of the measurements of the "solar constant" of radiation have been based on bolometric observations, between wave-lengths 0·387 μ and 2·428 μ, of the intensity of the solar spectrum given by a 60° flint-glass prism. One by-product of the research was a determination of the form of the solar spectrum energy curve as it would be outside the earth's atmosphere. The results of two other independent computations of the solar constant are now given from observations on Sept. 15, 1908, and the values, 2·020, 2·034, are in very good accord, differing by little more than 0·5 per cent. Recent observations have been treated by Goldhammer's method for determining the effective temperature of the sun, the resulting value being 6,200° C. (abs.). Considerable differences have been observed in the distribution of energy throughout the spectrum at various epochs. Thus in 1908 the violet region was decidedly weaker than in 1906, as compared with the intensity of the red radiations. It is hoped to test if this is due to instrumental errors by employing a quartz prism and magnalium mirrors in place of the present glass and silver outfit. By means of improved types of pyrheliometers corrections have been determined to the old values of the solar constant given for 1902–1906 [Abstract No. 1880 (1908)], indicating that the numbers then given should be raised about 2·6 per cent. C. P. B.

1366. *Helium Absorption near Sun-spots.* **R. A. C. Daunt.** (Roy. Astronom. Soc., Monthly Notices, 69. pp. 608–609, May, 1909.)—Observations made with a Thorp prism-grating spectroscope on a 8-in. equatorial refractor, in continuation of those published in 1908 [Abstract No. 1882 (1908)]. The D_3 line was only intermittently visible, and had generally a broken appearance. In every case the phenomenon was accompanied by notable distortions of the hydrogen line H_α. A table is given showing the various observations, with the type of spot group and corresponding behaviour of the hydrogen line. **A. L. Cortie.** (Ibid. pp. 609–610.)—The reversals have for the most part taken place in the earlier or disturbed periods of the life-histories of the spots examined. The area between the two main spots of a typical group is the seat of the majority of appearances of dark helium. In the column of percentages a great increase occurs between Jan. and March. There was also a great decline both in number and areas of spot groups during this period, but the diurnal range of the declination magnet increased in the same period. C. P. B.

1367. *Monochromatic Photographs of Sun with Hydrogen Light.* **H. Deslandres** and **L. d'Azambuja.** (Comptes Rendus, 148. pp. 1235–1239, May 10, 1909.)—Tracing the varying appearance of the flocculi areas depicted on spectroheliograms of the solar surface, it is shown that they increase both in brilliancy and extent with increase of altitude above the photosphere. Using a more powerful spectroheliograph, with secondary slit of silver on glass only 0·08 mm. wide, it has been possible to isolate light from either the middle or the edge of the H_α line, and the two resulting images are found to present important differences. Direct photographs of the line with a widened slit and high dispersion show the line to be sinuous, and this fact may account for the dark flocculi obtained by Hale with hydrogen radiations.
C. P. B.

1368. *Solar Activity Period of 85 Years.* **C. Easton.** (Konink. Akad. Wetensch. Amsterdam, Proc. 11. pp. 842–847, May 24, 1909.)—An investigation has been made by E. Dubois of the oscillations in level of the subsoil water in the dunes of Holland, indicating a periodic rise and fall agreeing in a remarkable way with the 85-year variations of meteorological phenomena described by E. Brückner. W. J. S. Lockyer tried to show that a similar period exists in the fluctuations of solar activity and terrestrial magnetism, deriving the period mainly from the form and amplitude of the sun-spot area curve since 1834. Easton gives reasons for doubting the validity of this long solar period, showing that the real course of the solar activity since 1900 has been contrary to Lockyer's prediction from his 85-year curve. C. P. B.

1369. *Gravitative Strain upon the Moon.* **E. McLennan.** (Nature, 80. pp. 276–277, May 6, 1909.)—In calculating the force required to hold the moon in its orbit, the decrease of gravitative force with distance must be taken into account. When this is done the force comes out as 6¾ × 10^{18} tons, which could be borne by a steel rod 6¼ miles thick instead of 400 miles.
E. E. F.

1370. *Observation of the Total Lunar Eclipse of June 3, 1909, at Toulouse.* **L. Montangerand.** (Comptes Rendus, 148. pp. 1577–1579, June 14, 1909.)—It is a well-known fact that during total eclipse the moon's disc is frequently seen tinted dull red. On previous occasions the author has succeeded in obtaining photographs of the entire disc by means of panchromatic plates, giving exposures of 10 to 15 min. At the eclipse of June 8, 1909, the new Lumière plates *étiquette violette* were tried, exposures of 1, 2, 3, and 4 min. being made in the photographic equatorial of the International Chart. The results showed that the durations were underestimated, and that 5 min. would have been required. The 4-min. exposure showed almost the entire disc, but only the brighter portions were visible with the shorter exposures. A. E.

1371. *Photographs of Jupiter.* **J. H. Reynolds.** (Roy. Astronom. Soc., Monthly Notices, 69. pp. 511–512, April, 1909.)—A series of photographs were obtained with the 24-in. coelostat reflector of 88 ft. focal length, the primary image being enlarged from three to four times with a Cooke negative lens. The scale is sufficiently large to show such phenomena as the shadows of satellites, the exposure being about 8 sec. for an equivalent focal length of 180 ft. The most characteristic feature of the photographs taken during the 1908–1909 opposition was the lack of contrast between the belts and the zones. Visually the belts now appear of a light brick-red colour, the principal exception being the north equatorial belt, which is dark grey. This distinction is well shown on the photographs. C. P. B.

1372. *Jupiter's Galilean Satellites.* **R. T. A. Innes.** (Roy. Astronom. Soc., Monthly Notices, 69. pp. 512–538, April, 1909.)—Observations of the four larger Jovian satellites, made with a 9-in. Grubb refractor and positive eyepiece giving magnifying power of 70. The details are given under the headings of (*a*) phenomena of transits, occultations, and eclipses; (*b*) sizes; (*c*) surface markings, &c. C. P. B.

1373. *Remarkable Transit of Jupiter's Third Satellite.* **R. T. A. Innes.** (Astronom. Nachr., No. 4,324. Nature, 80. pp. 409–410, June 8, 1909. Abstract.)—Observed at the Johannesburg Observatory on April 8, 1909, the transit of JIII. showed certain peculiarities. Before and after the transit the north polar cap and the dark marking along the north torrid zone of the satellite were noticed. When about three-quarters across a double dark spot was seen, which near the limb changed to a bright spot that gradually increased in size until internal contact took place. C. P. B.

1374. *Atmospheric Transmission by Night and Day.* **F. W. Very.** (Astrophys. Journ. 29. pp. 325–327, May, 1909.)—It having been announced by C. Nordmann that "in many cases, especially when it is very clear, the distribution of atmospheric absorption in the spectra of the stars appears to be notably different from what it is when studied in the solar spectrum," Very attempts to prove that this is only apparent, and may be due to the great range of sensitiveness of the eye for different colours. So far as photometric comparisons are concerned, the eye is much more sensitive to violet at night in a feeble light than by day in strong illumination. However, even this cause is insufficient to reverse the usual great absorption of ultra-violet rays at very low altitudes of the sun, and Nordmann finds that when the zenith distance exceeds 70° the ordinary daylight law of intensity is restored. C. P. B.

1375. *Number of Faint Stars with large Proper Motions.* **H. H. Turner.** (Roy. Astronom. Soc., Monthly Notices, 69. pp. 491–495, April, 1909.)—By comparison and examination of 80 plates in the zone + 26°, it is shown that the number of stars with large proper motions is not much greater for a plate in the Milky Way containing 800 stars than it is for one in a region far removed from the Galaxy, having only 50 stars on it. C. P. B.

1376. *Peculiar Spectroscopic Binaries.* **E. B. Frost.** (Astrophys. Journ. 29. pp. 284–286, April, 1909.)—Special interest is centred in stars of the Orion type in which chief lines are broad, while H and K calcium lines are narrow and sharp, *e.g.*, δ Orionis and *g* Camelopardalis. Moreover, the velocity given by these lines is different from that given by the diffuse lines. Twenty-five stars have been found showing this spectrum. C. P. B.

1377. *Titanium Oxide Flutings in Spectrum of o Ceti.* **A. Fowler.** (Roy. Astronom. Soc., Monthly Notices, 69. pp. 508–510, April, 1909.)—It has been shown in previous papers that nearly all the characteristic flutings of the Antarian or Third type stars are produced by the absorption of titanium oxide. For the comparison use has been made of the excellent spectrum of o Ceti (Mira) obtained by Slipher at the Lowell Observatory [Abstract No. 977 (1907)], and a reproduction is given showing the coincident details in the stellar and laboratory spectra. The titanium fluting spectrum was obtained from the arc flame when a considerable quantity of the substance was volatilised on iron poles. The two spectra are for the greater part identical, and the wave-lengths of the more conspicuous flutings are shown in tabular form. In each group the more refrangible component is the strongest, except in the third fluting. From a detailed study of these spectra, it is seen that Dunér's band 3, and possibly band 1, is not yet completely accounted for. Besides the bands, the spectrum of o Ceti shows bright lines of hydrogen, and certain metallic lines which Slipher has shown to be due to vanadium; others are probably due to iron and titanium. C. P. B.

1378. *Binary Variable Star RZ Cassiopeiæ.* **J. Stein.** (Astrophys. Journ. 29. pp. 308–312, May, 1909.)—An investigation to determine if the light-curve, plotted from an absolute scale of photographic magnitudes, can be represented by the satellite theory, shows that the *mean* light curve is reproduced with great accuracy. The observed asymmetry may be found to be unreal, but in any case is only disturbing on part of the curve near minimum. A set of computed elements of the orbit are given, assuming that the orbit is circular, and that the two components are of the same mean density. C. P. B.

1379. *Radium in Spiral Nebulæ and Star Clusters.* **M. B. Snyder.** (Science, 29. pp. 865–869, May 28, 1909.)—From a comparison of the published spectra of radium emanation [Abstract No. 2543 (1904)] the author adduces a possibility of transformation of the chemical elements at various stellar temperatures. The lines photographed in various spiral nebulæ at the Lick Observatory by Foth are compared with the spectra of radium by Ramsay, Rutherford, &c. Various coincidences as far as the third place are shown, but the intensities of the lines are not relatively in agreement. C. P. B.

REFERENCES.

1380. *On the Stability of Jacobi's Ellipsoid.* **G. H. Darwin.** (Roy. Soc., Proc. Ser. A. 82. pp. 188–189, May 6, 1909.)

1381. *Methods of Levelling Polished Surfaces for Microscopic Examination.* **R. Baumann.** (Metallurgie, 6. pp. 407–408, June 22, 1909. Communication from the Materialprüfungsanstalt an d. k. techn. Hochschule, Stuttgart.)—Describes some interesting devices for the mounting of both small and heavy metallographic specimens for microscopic examination. F. C. A. H. L.

1382. *Microstructure of Portland Cement.* **E. Stern.** (Königl. Materialprüfungsamt, Mitt. 27. 1. pp. 7–16, 1909.)—[See Abstract No. 1895 (1908).]—Numerous photomicrographs are given. F. R.

1383. *Elementary Lessons in Undulatory Motion.* **A. Bernini.** (N. Cimento, 17. pp. 179–186, March, 1909.)—A series of experiments is described by which the fundamental laws of undulatory motion, $v=\sqrt{(T/M)}$, and $n=(1/2l)\sqrt{(T/M)}$ may be directly demonstrated. The apparatus required consists merely of two rubber cords of different diameters, a rubber tube filled with mercury or small shot, a metronome, and weights. W. H. St.

1384. *The Wave-making Resistance of Ships: A Theoretical and Practical Analysis.* **T. H. Havelock.** (Roy. Soc., Proc. Ser. A. 82. pp. 276–300, May 26, 1909.)

1385. *Deformation Speed and its Influence on the After-effects.* **P. Ludwik.** (Phys. Zeitschr. 10. pp. 411–417, June 15, 1909.)—Describes with 2 tables and 9 curves experiments on the elongations of wires made (1) with various constant loads and (2) with various constant speeds of elongation. E. H. B.

1386. *Earthquakes.* **B. Golicyn [Galitzin].** (Acad. Sci. St. Pétersbourg, Bull. 5. pp. 323–324, March 15, 1909.)—From seismographical data obtained at Pulkovo, Irkutsk, and Tiflis, the author has calculated the distances of the epicentre for the two earthquakes of March 12 and 13, 1909, respectively. The results agree well among themselves, those for March 13th being confirmed by information received from Tokyo. T. H. P.

1387. *Gravitation Law at Molecular Distances.* **J. Radakovits.** (Phys. Zeitschr. 10. pp. 260–261, April 15, 1909.)—Analytical setting of attraction formula at minute distances between the gravitating centres. C. P. B.

1388. *Moving Force of Celestial Bodies and Gravitation.* **H. Wilde.** (Manchester Lit. and Phil. Soc., Mem. 53. 2. pp. 1–9, 1908–1909.)—Remarks drawing attention to the Newtonian definition of momentum as being identical with moving force, whereas the latter involves the square of the velocity impressed on the moving body. Calculations are given in detail for the fall of the moon towards the earth, and tables given showing the constants for the motions of the other planets. C. P. B.

1389. *Earthquake of June 11, 1909.* **A. Angot.** (Comptes Rendus, 148. pp. 1640–1641, June 14, 1909.)—Details of seismographic measurement of the disastrous earthquake of June 11, 1909, which was recorded at Parc-St. Maur. As this is the most serious earthquake in France since that of Feb. 23, 1887, the discussion of collected details from various stations may prove important. C. P. B.

1390. *Orbits of Spectroscopic Binaries.* **R. H. Baker** and **F. C. Jordan.** (Publications of the Allegheny Observatory, Vol. 1. Nos. 10, 11, 12. Nature, 80. p. 229, April 22, 1909. Abstract.)—In the first paper the star α Virginis is discussed, the final elements showing a period of 4·01416 days, eccentricity 0·10, and apparent semi-major axis 6,980,000 km. The second paper deals with μ Herculis, and the third with α Coronæ Borealis, in a similar manner. C. P. B.

LIGHT.

1391. *Double-Image Coelostat for Lunar Determinations.* **E. B. H. Wade.** (Cairo Scientific Journal, vol. iii., No. 30, p. 64, March, 1909. Nature, 80. p. 468, June 17, 1909. Abstract.)—The author has adapted the apparatus, designed originally for lunar determinations of longitude [Abstract No. 1381 (1908)], to the inverse problem of finding the moon's position when the longitude is known. The two mirrors of the former instrument are combined in a single one having two inclined faces, one of which is arranged to reflect the moon's image, the other the stars in the required region. To obviate difficulties due to the moon's motion an adjustable prism is adopted, and then the resulting photograph shows the lunar image among a set of star images, permitting of the measurement to a very fine degree of accuracy.
C. P. B.

1392. *60-inch Reflector of the Mount Wilson Solar Observatory.* **G. W. Ritchey.** (Astrophys. Journ. 29. pp. 198–210, April, 1909.)—The telescope was completed in Dec., 1908, and the first series of tests indicated that the performance of the instrument was very perfect in all respects. It has been designed to act in four different ways, according to the nature of the investigations to be made with it. About 95 per cent. of the weight (some 28 tons) has been taken off the bearings by floating the head of the polar axis in a mercury trough, the mounting being so designed that the centre of weight of the moving parts is vertically above the centre of flotation. A special feature of interest is the new system of construction employed for the dome. This is made of steel, with air-tight windows, ventilators, &c., so that after a night's work the whole of the cool air (120,000 cub. ft.) can be enclosed during the day. The roof and walls are double, and by this means it is hoped that it may be possible to keep down the variations of temperature. Comparisons with the performance of the 24-in. mirror constructed by Ritchey at Yerkes show that the definition of the 60-in. is decidedly superior, and the mounting being found quite rigid it will doubtless be possible to extend the work on stellar spectra and forms of celestial objects much beyond present limits.
C. P. B.

1393. *Reannealed Prisms.* **E. B. Frost.** (Astrophys. Journ. 29. pp. 233–234, April, 1909.)—In the preliminary tests of the prisms for the Bruce spectrograph of the Yerkes Observatory certain defects were found which were attributed to strain, and after consultation with the makers of the glass it was decided to have the prisms reannealed. After this they were refigured, and it was found that the definition had been very greatly improved. This experience may be useful to other workers having large expensive prisms of inferior performance, as if their lack of homogeneity is due to strain in annealing there is a possibility of its being remedied.
C. P. B.

1394. *New Method for Metallic Dispersion Determination.* **A. L. Bernoulli.** (Ann. d. Physik, 29. 3. pp. 585–604, June 10, 1909.)—In all the methods hitherto applied the fundamental principle depends upon the finding an angle of reflection for which the phase-difference equals $\pi/2$, so that the reflected light is *circularly* polarised. But the so-found principal angle of incidence has another characteristic property: the azimuth of the restored (plane) polarisation is for the principal angle of incidence a pronounced minimum. The new method here applied makes use of this principle. A series of angles of incidence and corresponding azimuths are measured: that angle of incidence, whose azimuth is a minimum, is accordingly the principal angle of incidence, the corresponding azimuth the principal azimuth. The half-shadow apparatus of Lippich was used for the azimuths, the source of light being a quartz mercury lamp by Heraeus. The results are contained in 21 tables, electrolytic nickel and hardened steel being dealt with. The chief results are summarised in the single table below:—

Waves and Colours.	Dispersion of Refractive Indices.		Dispersion of Reflection Coefficients.	
	Nickel.	Steel.	Nickel.	Steel.
615 Hg	1·846	—	66·8	—
D line Hg, yellow	1·747	2·435	—	59·4
E 550 Hg, green	1·759	2·190	63·9	58·6
F 500 Hg, blue-green	1·741	1·778	63·1	59·6
G 450 Hg, violet	1·786	1·762	61·9	58·6

E. H. B.

1395. *Motion of the Energy during Total Reflection.* **A. A. Eichenvalid [Eichenwald].** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 41. No. 8. pp. 131–158, 1909.)—Defining a light-ray as stream-lines of energy, and regarding these stream-lines as being everywhere perpendicular to the magnetic and electric lines of force, the author gives a graphic explanation of the process of total reflection. In such case there arises in the second medium a phase-difference of the X and Z components of the field intensity, rotating fields being formed in the ZX plane. Consequently the energy stream-lines must change their direction with the time and position. The figure representing the lines of force and energy stream-lines moves in the direction of X with a uniform velocity, which is equal to the phase-velocity along X. In the first medium all the resultants of the incident and reflected rays exhibit quite analogous phenomena. The lines of force here form closed curves, which, without altering their shape, move in the direction X. The energy forms a standing wave, progressing periodically in the direction X. On account of the conditions at the limiting surface the lines of electric force undergo refraction even when there is total reflection, and partially enter the second medium; at the same time energy also enters the second medium, but at different times for different places on the limiting surface. The energy or the light-ray, which enters the second medium at any place, is only perceptible at an inappreciable depth below the surface, as it immediately describes a curved line and passes out at another part of the surface into the first medium; the ray thus appears to be totally reflected. T. H. P.

1396. *Abnormal Propagation of Spherical Waves at Foci.* **F. Reiche.** (Ann. d. Physik, 29. 3. pp. 401–440, June 10, 1909. Physikal. Inst. d. Univ., Breslau, March, 1909.)—This is a continuation of the subject of a former article [see Abstract No. 1025 (1909)], and concludes with the following statements: (1) As "luminous point" a rectilinearly vibrating electron was assumed. When the spherical wave diverging from such a "point" is by any mechanism brought to a focus, the electromagnetic field at that focus is finite. (2) If one considers the wave approaching the focus and then passing away from it, then the electric vector suffers a change of algebraic sign at the focus, the magnetic vector meantime remaining unchanged. (3) These relations may be modified (as, for example, when a lens is used for producing the focus) by the diffraction at the boundaries of the radiation, so that both vectors appear unchanged in passing the focus. E. H. B.

1397. *Optical Constants of Liquid Crystals.* **E. Dorn** and **W. Lohmann.** (Ann. d. Physik, 29. 3. pp. 533–565, June 10, 1909.)—The authors have measured the refractive indices of ethyl ethoxybenzalamino-α-methylcinnamate and ethyl ethoxybenzalamino-α-ethylcinnamate for the isotropic phase and the ordinary ray of the crystalline liquid phase. The principal extraordinary indices have been obtained by means of the rings formed in convergent polarised light. The indices vary considerably with the temperature. The double refraction of these substances is quite twice as great as that of calcspar. In the two crystalline liquid phases the two substances follow quantitatively the same law as do solid uniaxial crystals; this observation is regarded as a further strong argument against the emulsion theory of crystalline liquids. T. H. P.

1398. *Elliptic Polarisation.* **L. Natanson.** (Acad. Sci. Cracovie, Bull. 1. pp. 25–37, 1909.)—Discusses some further points in the theory of circular dichroism in naturally active media [see Abstract No. 1940 (1908)], or the unequal extinction of the circular components into which a linearly polarised wave of light can be resolved. The orientation of the resultant ellipse does not obey Babinet's rule, which states that the fastest ray is the least absorbed. In mono-electronic media the reverse of this rule holds good. The new rule is tested by Cotton's results, obtained with solutions of copper tartrate in caustic potash and alkaline tartrates in chrome alum. E. E. F.

1399. *Polarising Effect of Coelostat Mirrors.* **C. E. St. John.** (Astrophys. Journ. 29. pp. 301–304, May, 1909.)—In discussing the investigation of the Zeeman-effect in sun-spot spectra at Mount Wilson it was recognised that circularly polarised light would become elliptically polarised by reflection from the silvered surfaces of the coelostat mirrors, and that its effect would vary with the angles of incidence, and hence with the position of the sun. Light of a known degree of polarisation was allowed to fall on the actual mirrors used, and the resulting change by reflection from the mirrors measured at many angles. The results gave a table of corrections that could be applied to the actual solar observations. C. P. B.

1400. *Absence of Polarisation in Artificial Fogs.* **C. Barus.** (Amer. Journ. Sci. 27. p. 402, May, 1909.)—In Tyndall's well-known experiment with motes of mastic suspended in water there is a remarkable completeness of polarisation of the light reflected or scattered at right angles to the impinging beam. With a double-image prism only one of the beams is visible in the turbid water. Barus has found in making the experiment with dense fogs that there is an almost entire absence of this discriminating character, both beams being always in view and about equally intense. The fogs were produced with phosphorus nuclei, and the equally brilliant beams on examination with a nicol were found to be polarised at right angles to each other. This last observation indicates that the vibration which is horizontal outside has been turned about 90° in a horizontal plane after entering the fog-chamber.

J. J. S.

1401. *Intensities of Calcium Lines in Furnace Spectra.* **A. S. King.** (Astrophys. Journ. 29, pp. 190–197, April, 1909.)—A series of experiments undertaken to determine the effect of variations of temperature on the various lines in the calcium spectrum, special attention being paid to some 20 lines between $\lambda 5857$ and $\lambda 6718$. The results show that very conspicuous changes occur with different lines; the low-temperature lines strengthen but slowly with rising temperature, while a number of lines barely visible at the lower temperature attain considerable strength with higher temperatures. [See Abstracts Nos. 60, 447 (1909).]

C. P. B.

1402. *Dissymmetrical Broadening of Lines in Arc Spectra.* **C. Fabry** and **H. Buisson.** (Comptes Rendus, 148, pp. 1240–1241, May 10, 1909.)—The authors have given in a previous note [Abstract No. 786 (1909)] the results of comparisons of the wave-lengths of lines in arc spectra and the solar spectrum. In general it was found that the displacement, passing from the arc to sun, was a few thousandths of an Ångström unit towards the red; this increase of wave-length has been ascribed to pressure in the solar atmosphere, corresponding to about 4 or 5 atmos. By examining the spectrum of the arc *in vacuo* many of the anomalies were explained by action of atmospheric pressure on special lines. The direct comparison of arc *in vacuo* with the solar spectrum shows a constancy of displacement equal to that of normal lines.

C. P. B.

1403. *The Flame-spectra of certain Metalloids.* **C. de Watteville.** (Zeitschr. wiss. Phot. 67, pp. 279–285, July, 1909. Translation.)—The flame-spectra are described of nitrogen, phosphorus, arsenic, and antimony as obtained with a coal-gas and air-blast flame and a Gouy disintegrator. The spectra consist of bands which are very regularly distributed. In the case of As and Sb there are a great number of lines which in appearance approach the arc-spectra. As the spectra are mainly confined to the region below $\lambda = 8000$, the author points out that it is impossible to speak of the absence or presence of these elements in the sun, since the solar spectrum does not extend beyond this limit.

E. C. C. B.

1404. *Phosphorescence at very Low Temperatures.* **H.** and **J. Becquerel** and **H. Kamerlingh Onnes.** (Konink. Akad. Wetensch. Amsterdam, Proc. 12. pp. 76–88, June 25, 1909.)—The phosphorescent spectra of uranyl salts are dealt with in this paper, the observations being made at temperatures of 80°, 20°, and 14° abs. It is noteworthy that the phosphorescence of these compounds does not decrease as the temperature is lowered and also that it vanishes when the exciting light is removed. The bands of the spectra which between ordinary temperature and that of liquid air undergo subdivision into lines, become groups of even finer lines at the temperature of liquid hydrogen. With decrease of temperature the emission maxima shift towards the shorter wave-lengths, but the shift is not proportional to the temperature-change, and it is very possible that with the fall of temperature the bands asymptotically approach a limiting position. The spectrum of a definite salt consists of definite groups which, though not quite the same, still show a very small difference between successive groups. The bands which occupy the same relative positions in the different groups are called by the authors homologous bands. The differences between the frequencies of two successive homologous bands is practically constant, not only for the same, but also for all series of homologous bands of the same salt. Further, the values of this constant for the various salts differ but slightly from each other. In certain cases it was shown that certain bands can become either emission or absorption bands, or, in other words, it is possible to reverse some of the emission bands. E. C. C. B.

1405. *Radio-activity of Salts of Potassium.* **E. Henriot and G. Vavon.** (Comptes Rendus, 149. pp. 30–32, July 5, 1909.)—An attempt is made to concentrate the radio-active property of potassium salts by fractional methods, but with no success. The same has been found by N. Campbell and McLennan, and so it would seem fairly certain that the radio-activity is not due to some unknown impurity. Campbell has shown that the β-rays from potassium salts can be deviated by an electric field, and it is now proved that they can be deflected by a magnetic field in a direction which indicates that they are negatively charged. Hence the rays from potassium are now identified in a complete manner with the β-rays. A diagram of the apparatus used is given [see also Abstract No. 886 (1909)]. A. E. G.

1406. *Comparison between the α-rays produced by different Radio-active Substances.* **Mlle. Blanquies.** (Comptes Rendus, 148. pp. 1753–1756, June 28, 1909.)—It is generally admitted that the α-particles emitted by the various radio-active bodies differ only by their velocity of projection. If this is the case, then at the same distance from the end of their course all α-particles should present exactly similar properties. The object of the experiments is to verify this point. Taking care to work always with the same apparatus, and to employ active matter in infinitely thin layers, one is able to show by a curve the α-radiation of each active substance, and to compare the curves corresponding to the different substances. If the above hypothesis is true, and all the curves are constructed on the same scale, then they ought in part to be superposable. Experiments are carried out with polonium, RaC, and AcB. To obtain comparable curves in spite of the unequal activity of the products employed, after each experiment a first curve is constructed having for abscissæ the distances from the source to the ionisation vessel, and for ordinates the amount of ionisation produced. That for RaC is diminished by the amount due to β-rays. Variations of temperature and pressure are also allowed for. Several curves very similar to one another are constructed for the same substance by reducing all to a common maximum, and a mean is taken of all the curves so obtained. Such curves for RaC and polonium practically coincide, so that if it is allowed that the course in air of α-particles of RaC is 3 cm. more than that of α-particles of polonium these particles appear identical. On the other hand, the curve for AcB is quite different from these. In particular the decrease of activity starting from the maximum takes place much less quickly in this case. Two explanations are offered to account for this, (*a*) that the properties of α-rays vary with the nature of the bodies producing them, and (*b*) that all α-particles are identical, but that the radiation observed when employing as a source a surface made active by contact with actinium emanation is a complex one. The first is discarded on account of the close resemblance between the curves obtained for RaC and polonium. An attempt is made to construct a theoretical curve such as would be due to a double source of α-rays, but it does not fit well with the experimental one obtained for AcB. A. E. G.

1407. *Ionisation in various Gases by Secondary γ-Rays.* **R. D. Kleeman.** (Roy. Soc., Proc. Ser. A. 82. pp. 358–377, June 30, 1909.)—The author has previously described some experiments carried out with secondary γ-rays emitted by various substances exposed to the primary γ-rays of Ra [see Abstract No. 1096 (1908)]. It was found that the secondary rays are, on the whole, softer than the primary. It was thought, therefore, that the ionisation of gases by secondary γ-rays would probably differ in many features from that obtained by primary rays. A set of measurements on the ionisation produced in various gases by secondary γ-rays is therefore undertaken. It is found for air and ethyl bromide that the ionisation is proportional to the pressure between the limits of pressure used, so it is thought unnecessary to make further experiments with different gases in order to show that the ionisation varies with the pressure in each case. The nature and causes of the ionisation in the chamber are next considered, then the means of obtaining the various gases and vapours used. In the experiments, radiators of zinc, carbon, and lead are used, and the experimental results obtained are given in tables. In the first table the ionisations obtained with the primary γ-rays, the β-rays of Ur, and the α-particles from Ra are given for comparison. The second table contains results obtained with soft and hard primary Röntgen rays by McClung, Strutt, Eve, and Crowther. From the results it is deduced that the ionisation values for the primary and secondary γ-rays can be divided into three sets, the first consisting of gases whose molecules are composed of atoms of H, C, N, O, S, Cl; the ionisation values of these gases are practically the same for the primary and secondary rays in the case of each of the radiators used. In the case of gases containing atoms of higher atomic weight than Cl, however, there are considerable differences with primary and secondary rays, which depend on the nature of the radiator. Thus the ionisation in the first set of gases, and probably in all gases (except hydrogen) composed of atoms of low atomic weight, is practically independent of the penetrating power of the γ-rays. A comparison of the ionisation values of gases of the first set obtained with α-rays and β-rays and the primary and secondary γ-rays shows that they are approximately the same for each kind of ray. The second set in the table consists of gases whose molecules contain at least one atom which is of greater mass than the Cl atom. The ionisation is greater in these gases with secondary rays than with the primary. The difference in ionisation increases with the atomic weight of the heavy atom in the gas, and is greatest with the carbon radiator, and smallest with the lead radiator. When ionisations obtained with the α-, β-, and γ-rays for the gases of this set are compared with one another, it is seen that on the whole they vary considerably with the nature and quality of the ionising agent. The third set in the table contains only hydrogen. The ionisation in this gas is found to be smaller with secondary than with primary rays; the ionisation thus increases with the penetrating power of the rays. The decrease is greatest with the carbon radiator and smallest with the lead. The ionisation in the various gases, omitting hydrogen, is approximately an additive quantity. It is shown that the sensitiveness of an atom to the penetrating power of γ-rays increases with the atomic weight.

The departure of hydrogen from the additive law, and the increase of departure with the increase in the softness of the ionising rays, adds another anomaly to the list for which that gas is already noted. It is probable that these anomalies are due to the same cause, which is probably a departure in the arrangement of the forces of constraint holding the two atoms of the molecule together from the arrangement in the case when hydrogen is combined with other atoms. The nature of the secondary radiation from a plate is also found to depend on its direction of propagation with respect to that of the primary rays. It further appears that we cannot compare the ionisations in gases with the absorption of solid materials unless we know how the absorbed energy is distributed between the electrons of high and slow speed. [See also Abstract No. 1280 (1909).] A. E. G.

1408. *Relation of Recoil Phenomena to the Final Radio-active Product of Radium.* **J. C. McLennan.** (Nature, 80. pp. 490–491, June 24, 1909.)—Experimental evidence has been obtained by Miss Brooks, O. Hahn and L. Meitner, Russ and Makower, Debierne and Kennedy, which shows that when the expulsion of an α-particle or β-particle takes place the rest-atom undergoes a recoil; and this has been used in collecting disintegration products of the radio-active elements [see Abstracts Nos. 2614 (1904), 474, 649, 1053 (1909)]. The question naturally arises of a possible connection between this phenomenon and the final transmutation product of Ra. RaG (polonium) is known to emit α-rays, and when deposited on a plate of copper to emit a feeble δ-radiation. The recoil phenomenon should manifest itself here in the projection of atoms of the final radio-active product from such RaG-coated plates. Evidence of such projection has recently been obtained by V. E. Pound. An insulated copper plate A about 8 sq. cm. in area is coated with RaG and placed in a highly exhausted vessel facing a second insulated copper plate B. B is joined to an electrometer, and the electrical charges which it acquires under various electric and magnetic fields are observed. With moderate electric and magnetic fields the form of the charging curves shows that at least three types of radiation are present, viz.: (1) α-rays emitted by A; (2) easily absorbed δ-rays emitted by A; and (3) easily absorbed secondary radiation, consisting of negatively charged particles emitted by B. With higher magnetic fields an entirely new phenomenon appears, especially if plate A is charged to an increasingly high positive potential; for in this case the positive charge acquired by B gradually increases. As such high magnetic fields are sufficient to prevent the secondary radiation from leaving B, and the high positive potentials sufficient to retain the δ-radiation on A without affecting the α-radiation, it seems evident that the rise in the positive charge acquired by B is due to the existence of a radiation of negatively charged particles from A which have hitherto escaped detection, but are in these experiments deflected by the magnetic field. When A is neutral or negatively charged, the application of the magnetic field gives no indication of this radiation. If this new radiation consists of the rest atoms of RaG, we have in the property that it is projected with high velocity, and in that it carries an electrical charge, the means of ascertaining its mass. Such a knowledge would give definite information regarding the constitution of the final radio-active products of Ra. The experiments are being continued. A. E. G.

1409. *Heat of Polonium.* **W. Duane.** (Comptes Rendus, 148. pp. 1665–1667, June 21, 1909.)—In a preceding communication an account was given of a very sensitive method for measuring small quantities of heat [Abstract No. 1073 (1909)]. An experiment, using this method, is now described, the object of which is to measure the heat given off by polonium. In order to find out whether the heat set free by the radio-active bodies is equivalent to the energy of the rays from those bodies, a comparison is made between that liberated by polonium and that by Ra deprived of the emanation and of the induced activity. Both these substances give off only α-rays, and these have nearly equal free paths. That the comparison may be satisfactory the salt must be in a thin layer so that the α-rays may not be absorbed by the salt itself, and also the ionisation current must be easily saturated. A method is explained by which these conditions are fulfilled. It is found that the Ra which produces an equivalent ionisation to that of the polonium used, gives off also approximately the same amount of heat; this, it is concluded, is favourable to the hypothesis that the heat developed by these bodies is due to the kinetic energy of the α-rays. A. E. G.

1410. *Effect of Temperature on the Rate of Production of Uranium X.* **R. W. Forsyth.** (Phil. Mag. 18. pp. 207–209, July, 1909.)—Experiments on the rate of production of UrX in specimens kept respectively at atmospheric temperatures and at 1,000° C. are described. To prepare a salt of uranium as free as possible from UrX, the method previously described by Crookes is employed. The oxide so obtained is divided into two equal portions; these are enclosed in quartz tubes, one being kept at the temperature of the laboratory, and the other heated in a gas muffle furnace to a temperature of 1,000° C. The rate of formation of UrX is studied by measuring the β-ray activity by means of an electroscope. It is found in all cases that the change in the ratio (cold)/(hot) is not sufficiently decided to show that the rate of production of UrX at 1,000° C. is sensibly different from that at ordinary temperatures. A. E. G.

1411. *Distribution of Thorium in the Earth's Surface Materials.* **J. Joly.** (Phil. Mag. 18. pp. 140–145, July, 1909.)—A continuation of the author's work on this subject [see Abstract No. 1058 (1909)]. In the present paper results are given of determinations of the thorium content of 51 specimens of rock from the St. Gothard Tunnel. The means of the determinations for the several geological divisions into which Stapff subdivides the course of the tunnel are as follows:—

	Thorium, in gm. per gm. $\times 10^{-5}$.	Radium, in gm. per gm. $\times 10^{-12}$.	Uranium, in gm. per gm. $\times 10^{-5}$.
Granite and gneiss of Finsteraarhorn Massif ...	1·85	7·7	2·26
Altered sediments, Ursernmulde	0·97	4·9	1·44
Schists, &c., of St. Gothard Massif	1·18	3·9	1·15
Altered sediments, Tessinmulde.......................	0·51	3·4	1·00

The Ur is computed on Boltwood's measurement of the equilibrium amount of Ra in 1 gm. of Ur, $3{\cdot}4 \times 10^{-7}$ gm. In the author's address to Section C, Brit. Assoc., 1908, he drew attention to the correspondence between the radium content of the St. Gothard rocks and the distribution of temperature in the rocks as observed during the progress of the tunnel, suggesting that

the observed gradients may, in fact, be referable to radio-activity, wholly or in part. It will be seen that the radio-active energy due to thorium must also be predominant in that region of the tunnel in which the temperature gradients were found to be steepest; that is, in the Finsteraar granite, which is richest both in Ra and in Th. The thermal value of the latter element is not determinable without a knowledge of its rate of transformation or an experimental determination of its thermal output when in equilibrium with its transformation products. A misinterpretation of a passage in one of Soddy's papers led the author to believe that Soddy maintained the probability of equality between the rates of break up of Th and Ur. Soddy states that he did not intend to express that view. As in the case of the collective radium measurements now in our possession, so in the case of thorium according to the author's observations, sedimentary materials appear to reveal the denudative loss of radio-active materials. That Th is a generally distributed constituent of the earth's crust, and enters into the composition of deep-seated materials seems established by its universal presence throughout so vast and complex a region as that traversed by the Alpine tunnel, as well as by its presence in plutonic rocks and lavas of many ages and from many parts of the world, and in the waters and sediments of the ocean.
A. W.

1412. *Radium in Sea-water.* **A. S. Eve.** (Phil. Mag. 18. pp. 102-107, July, 1909.)—Describes fresh determinations of the amount of radium present in sea-water, the specimens being taken from the Atlantic at various places, and at once placed in clean, new bottles. All possible precautions were taken to eliminate error, and the mean result for the six samples was 9×10^{-16} gm. per gm. of sea-water. This is only about 1/17 of the value ($1{\cdot}6 \times 10^{-14}$) obtained by Joly, but agrees fairly well with the value 6×10^{-16} previously obtained by the author. It is also shown that when testing for the quantity of radium emanation present in a given solution, about equal accuracy is obtained by collecting the emanation over water or over mercury. A. W.

REFERENCES.

1413. *The Photo-heliometer.* **C. L. Poor.** (Astrophys. Journ. 29. pp. 318-324, May, 1909.)—A more complete treatment of the subject dealt with in Abstract No. 481 (1909)], giving the author's conclusions as to the methods to be employed for obtaining the best photographic results. L. H. W.

1414. *Improvement of Interference Spectroscope.* **E. Gehrcke.** (Deutsch. Phys. Gesell., Verh. 11. 6. pp. 141-145, March 30, 1909. Physikal. Techn. Reichsanstalt, Charlottenburg.)—Forms of prisms, suitable for improving the interference spectroscope, are suggested in addition to the method described by v. Baeyer [see Abstract No. 812 (1909)]. G. E. A.

1415. *Camera Objectives for Spectrographs.* **J. S. Plaskett.** (Astrophys. Journ. 29. pp. 290-300, May, 1909.)—It is well known that the camera objectives in general use for stellar spectrographic work have a very limited field of good definition, about 2°, covering in the usual dispersion of three prisms, about 200 tenth-metres. Numerous objectives of varying type have been examined with the Ottawa spectrograph and their performances plotted for comparison. [See Abstract No. 86 (1905).]
C. P. B.

HEAT.

1416. *Corrections for Enclosed Thermometers with Expansions of the Capillary.* **W. Meissner.** (Zeitschr. Instrumentenk. 29. pp. 98–108, April, 1909. Communication from the Physikal.-techn. Reichsanstalt.)—The author deduces expressions for the following corrections to be applied to enclosed thermometers, the capillary stems of which are widened at various points: (1) δ, the fundamental correction for thermometers consisting only of mercury and one kind of glass; (2) δ_1, the correction for different expansions of bulb and capillary; (3) δ_2, correction for different expansions of scale and capillary; (4) δ_3, correction for the scale being fixed at a point other than the zero point; (5) δ_4, correction for the expanded portions of the capillary, and (6) δ_5, correction for the variation of t_0 from zero. The sum of the corrections δ_2, δ_3, δ_4, and δ_5 is given for various readings on thermometers reading (1) from 0° to − 35° C.; (2) from 0° to 50° C.; (3) from + 50° to + 100° C.; (4) from + 100° to + 200° C.; (5) from + 200° to + 300° C., these sums being the numbers to be added to the readings of the thermometers to reduce them to the indications of thermometers of the same kind of glass with scales engraved on the stems. [Compare Thiesen, Metronom. Beitr. No. 3, Berlin, 1881; Wiebe and Moeller, Abstract No. 1118 (1908).] T. H. P.

1417. *Low-temperature Problems connected with Helium and Radium.* **J. Dewar.** (Engineering, 87. pp. 825–826, June 18, 1909. Discourse delivered at the Royal Institution, June 11, 1909.)—Vacuum vessels are now made of metal (nickel), and an ordinary vacuum-jacketed glass cylinder is used as a cap over the mouth of the metal vessel. Some charcoal is put in the jacket of the nickel walls. The boiling-point of He is 4·5° abs., its critical temperature 5·5° abs., and its critical pressure 2¼ atmos. By evaporation of He under reduced pressures Onnes has reached a temperature of 3° abs. Should some element exist of still lower boiling-point than He it might be possible to reach 1° abs. or even 0·5° abs., but not absolute zero. By means of a stream of gas passing through a discharge tube and a long-exhausted glass cylinder the phosphorescence of air, CO_2, nitrogen, and oxygen can be demonstrated. When hydrogen is used no luminosity is visible, and a trace of this gas, or any volatile organic compound (*e.g.*, ether), will prevent phosphorescence in the other gases named. It is shown that in all cases, whether the stream of gas is luminous or dark, it is strongly ionised. The phosphorescence might be due to formation of ozone or nitrous compounds. It is now known that bodies like ozone and the nitrous oxides are produced from dissociated molecules at high temperatures, and that these bodies are very unstable. This may give a clue to the formation of radioactive substances. A. E. G.

1418. *Latent Heat of Steam between* 100° *and* 180°. **F. Henning.** (Ann. d. Physik, 29. 3. pp. 441–465, June 10, 1909. Communication from the Physikal.-techn. Reichsanstalt.)—The method adopted was the same as that which the author employed over the range 30°–100° [Abstract No. 432 (1907)]. The water was vaporised by means of an electrical heating coil, the energy supplied being measured and the quantity of steam generated being determined by weighing, after passing it through a condenser. The temperature of boiling could be maintained at any desired value by means of compressed air. The heating coil consisted of a wide constantan band wound in a groove on a hollow clay cylinder, the current being led in by copper conductors. From 8 to 12 gm. of water could be vaporised per min., and the heat developed in the conducting wires was vanishingly small. For the calculation of the latent heat 4·188 joules were taken as the equivalent of the calorie at 15° C. In discussing the advantages of this method the author points out that when all parts of the measuring apparatus are at constant temperature the thermometer really acts as a null instrument. The experimental results obtained for the latent heat only differ in the most unfavourable case by one part in a thousand from the mean value obtained from the curve of results. It was not possible to obtain a single formula which would represent all the results to the same degree of accuracy. Below 100° C. the author had found that the Thiesen exponential formula $L = A(365 - t)^n$ would represent the observations. But above 100° C. it was found that this law was not so satisfactory, since it gave values at 140° and 180°, which differed from the observations by 0·8 per cent. and 0·2 per cent. respectively. A better result could be obtained by adopting the parabolic formula—

$$L = 538{\cdot}46 - 0{\cdot}6522(t - 100) - 0{\cdot}000833(t - 100)^2,$$

but it is subject to the disadvantage that L vanishes for $t = 606$. If, however, we consider the region 120°—180°, it is possible to represent the results as a linear function of the temperature—

$$L = 539{\cdot}66 - 0{\cdot}718(t - 100).$$

W. C. S. P.

1419. *Evaporation of Aqueous Solutions.* **P. Vaillant.** (Comptes Rendus, 148. pp. 1099–1102, April 26, 1909.)—The author has shown previously [see Abstract No. 1981 (1908)] that the addition of sulphuric acid to water does not alter the constant B of the evaporation formula, $q = BS(F - f)/H$, if F, the max. pressure of pure water, is replaced by F′, the pressure of the solution obtained; the factor B has the same value for sulphuric acid and for water. Experiments with solutions of potassium and sodium hydroxides, phosphoric acid, potassium bromide and iodide, sodium chloride and nitrate, lithium and calcium chlorides, and glycerol lead to the conclusion that, except with potassium hydroxide solutions, a solution constantly maintains in the immediate neighbourhood of its surface a layer of saturated air, the velocity with which this layer diffuses into the surrounding air alone determining the rapidity of evaporation of the solution.

T .H. P.

1420. *Emissive Power of Black Bodies.* **V. Polara.** (Accad. Lincei, Atti, 18. pp. 518–518, May 16, 1909.)—Wien's formula, $E_\lambda = c/\lambda^5 e^{-c_1/\lambda I}$, may be deduced mathematically from Planck's formula summarising the three laws of Kirchoff, Stefan-Boltzmann, and Wien, viz., $E_\lambda = c/\lambda^5 \psi(\lambda I)$, where c is a constant and ψ a function of the product λI. Wien based his formula on Michelson's hypothesis, but overlooked the fact that, according to the latter, the radiation emanating from any molecule is proportional to a known function of its absolute temperature, while a further error was introduced by neglecting the factor $I^{-3/2}$ in the application of Maxwell's formula for the distribution of velocities in a great number of molecules. Rectifying these two omissions, the author deduces the formula $E_\lambda = c/\lambda^5(\lambda I)^n e^{-c_2/\lambda\sigma}$, where c is a new constant. This formula is analogous to that obtained by Rayleigh in another way, and is free from the objections of Wien's formula.

W. H. St.

SOUND.

1421. *Gramophone as Phonautograph.* **J. G. McKendrick.** (Nature, 80. pp. 188–191, April 15, 1909.)—It is well known that during the last few years the gramophone (invented by Berliner in 1887), in its more complete and expensive forms, has been so much improved as to have completely eclipsed the phonograph. It is now an instrument that not only records pitch and intensity, but also quality to a surprising degree, so that one can listen to orchestral music in which the quality of each musical instrument is rendered with much fidelity, and also to the fine voices of many of the most celebrated vocalists of the day. Chorus effects are also remarkable. The nasal effects, the thin reediness of the voices, the alterations in quality, so characteristic of the phonograph, and of the gramophone in its earlier stages, have now almost entirely disappeared. Certain data respecting the gramophone disc are then given. In one case, in reproducing a waltz, the needle ran over a distance of 550 ft. in 205 sec., giving a speed of 32·2 in. per sec. With larger discs the length of the groove may be over 200 yards. The use of the gramophone as phonautograph is then described, a smoked glass disc being placed instead of the record and the finest needle used. A method of coupling two gramophones is also described, one having the usual record and giving the sound, the other having a smoked glass plate and receiving the sound and producing the recording trace. The paper has three illustrations of the effects obtained on glass plates. E. H. B.

1422. *Sub-Harmonics.* **G. Sizes** and **G. Massol.** (Comptes Rendus, 148. pp. 1318–1319, May 17, 1909.)—Continuing their work on the *grave* or sub-harmonics of a fork of 96 vibrations [see Abstracts Nos. 89 and 646 (1908)] the authors have found 16 more in addition to the previous 10, making 26 sub-harmonics in all, including the lowest, not yet registered, but which they believe to exist. Their frequencies are respectively: (1), 2, 3, 4, 5, 6, 8, 9, 12, 14, 15, 16, 18, 21, 24, 27, 28, 30, 32, 36, 48, 56, 60, 64, 72, 84; 96 being the nominal frequency of the fork. They have also found 5 more overtones, making the total number of tones or vibrations from the fork 58. E. H. B.

REFERENCES.

1423. *Theory of Combination Tones.* **E. Waetzmann.** (Ann. d. Physik, 28. 5. pp. 1067–1078, March 30, 1909. Physikal. Inst., Breslau, Feb., 1909.)—The author here discusses the views of L. Hermann as to the acceptance of Helmholtz's theory of combination tones, which theory is here defended in the light of Waetzmann's own experiments. [See also Abstracts Nos. 1739 (1906), 1042 (1907), and 95 (1908).] E. H. B.

1424. *Vowel Synthesis.* **K. v. Wesendonk.** (Phys. Zeitschr. 10. pp. 313–316, May 1, 1909.)—A discussion of the various tones from which it is possible to effect vowel synthesis, with special reference to the work of Helmholtz and of H. Grassmann. The author hopes to pursue the matter further later on. E. H. B.

1425. *Vibrations of Tuning-fork Stems.* **E. Waetzmann.** (Phys. Zeitschr. 10. pp. 409–411, June 15, 1909. Physikal. Inst., Breslau, April, 1909.)—Deals with the longitudinal and transversal vibrations of the stems of tuning-forks which occur when the prongs are vibrating. E. H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1426. *Electric Fields of Force.* **C. Somigliana.** (N. Cimento, 17. pp. 48–65, Jan.–Feb., 1909. Communication from the Italian Soc. for Advancement of Science, Florence, Oct., 1908.)—A mathematical discussion of the possibility of deriving Maxwell's stresses from the mechanical principles of elasticity. The cases are considered of (*a*) a sphere subjected to its own gravitation; (*b*) a uniformly electrified sphere. In the latter case the pressure normal to the lines of force is half the tension along them, and the latter varies inversely as the third power of the radius. E. E. F.

1427. *Pure Electromagnetic Fields.* **U. Cisotti.** (N. Cimento, 17. pp. 108–111, Jan.-Feb., 1909.)—A further investigation of the equations governing the motion of pure electricity unconnected with matter, previously discussed by Levi-Civita and Caffaratti [Abstracts Nos. 2078 (1907), 1488 (1908)]. The medium S, in which the spontaneous motion is to occur, is limited by two planes. The inquiry relates to the question whether a pure electromagnetic field can be maintained in S by a regular movement of electricity producing a uniform field. The question is answered in the affirmative. E. E. F.

1428. *Electron Theory.* **L. Silberstein.** (Ann. d. Physik, 29. 3. pp. 523–532, June 10, 1909.)—After mathematical discussions and criticisms of various matters in electron theory, the author specially considers the assumption of an electron unlimited in space with an exponentially diminishing charge as previously alluded to [Abstract No. 706 (1909)]. The electrical distribution of this electron is now defined by $\rho=\rho_0 e^{-r/\lambda}$, λ being a constant. The total charge is then shown to be given by $Q=8\pi\lambda^3\rho_0$. The longitudinal and transverse electromagnetic masses m_l and m_t are then expressed by $m_l=m_0/\gamma^3$ and $m_t=m_0/\gamma$, where $m_0=8Q^2/64\pi c^2\lambda$ and $\gamma=\sqrt{1-v^2/c^2}$, v being the speed of the electron and c that of light. The variation of mass with speed is thus seen to be the same as in the limited Lorentz electron, and will therefore agree just as well with experiments. It should be noted also that this unlimited electron is supposed to suffer the Lorentz deformation with motion, *i.e.*, a shrinkage from 1 to $1/\gamma$ along its direction and no change along the two perpendicular axes. E. H. B.

1429. *A Curious Property of Neon.* **J. N. Collie.** (Roy. Soc., Proc. Ser. A. 82. pp. 378–380, June 30, 1909.)—The glowing of gases when shaken with mercury in a tube is well known, but neon shows this peculiarity even at atmospheric pressures in such a marked manner that the phenomenon has been further investigated. Before filling the tubes with neon, they are thoroughly cleaned with sulphuric acid and chromic acid. Some mercury is then put into the tubes and they are sealed on to the Töpler pump and pumped out; the mercury in the tubes is then boiled and the pump washed out with some neon; the tubes are again pumped out, and finally pure neon admitted; the pressure in the different tubes is varied from 120 to 200 mm., the glow being as bright at these as at ordinary pressures. It is found that the glow is not always produced when the tube containing neon and mercury is shaken; thus, after shaking intermittently for 2 or 3 hours, the glow becomes very feeble and remains so for some days, but by enclosing the ends of the tube in lead-foil and passing sparks from an induction coil through it, the brilliancy at once returns, being brighter now at the positive end. Another tube which glowed brightly is brought near the terminals of the induction coil, when it loses most of its brilliancy, and no increase of brightness takes place by sparking; if, however, the tube is heated at one end, this end regains its property of glowing when the tube is shaken. Heating makes the glow more pronounced than cooling. If the neon has the slightest trace of moisture in it, no glow can be obtained; minute traces of CO also diminish the power of glowing in a marked manner, but spectroscopic traces of hydrogen do not seem to have much effect. The purer the gas the more difficult is it to destroy the glow by shaking or electrifying the tube. In a silica tube with neon at atmospheric pressure the glow is very much brighter than in a glass tube under the same circumstances. A. E. G.

1430. *Ionisation of the Air by High-tension overhead Wires.* **L. Houllevigue.** (Comptes Rendus, 148. pp. 1668–1670, June 21, 1909.)—A recent hailstorm, the direction of which coincided with a high-tension electric overhead transmission system, has given rise to the suggestion that possibly these lines play an important part in meteorology [see Abstract No. 1575 (1908)]. The author has carried out a series of experiments to test this point, using the electroscope and cylindrical condenser method perfected by Chéneveau and Laborde. The experiments were carried out in the neighbourhood of a three-phase 50,000-volt line. Samples of air close to the wires gave $0·05 \times 10^5$ ions per cm.^{3} Near the lightning arresters, &c., where there was a strong odour of ozone, the number was between 0·04 and $0·05 \times 10^5$ ions per cm.^{3} At a neighbouring town the number varied between 0·07 and 0·09. The author concludes from his experiments that very close to the wires there are sensibly no ions. It is ordinarily stated that the wires are continually giving out ions. But in all cases it was found that the number is less near the wires than in the neighbouring country. A. R.

1431. *Induced Activity on the High Sea.* **H. Sieveking.** (Phys. Zeitschr. 10. pp. 398–399, June 15, 1909. Physikal. Inst. d. techn. Hochschule, Karlsruhe, May 3, 1909.)—The experiments were made on a voyage from Alexandria to Naples. 10 m. of wire were exposed for 2 hours at a potential of 2,000 volts, and the rate of decay of activity of the collected emanation was subsequently determined. The results agree fairly well with those obtained by Curie for radium emanation, and thus indicate the presence of radium emanation over the sea. R. G. K. L.

DISCHARGE AND OSCILLATIONS.

1432. *Conditions for Production of Magnetic Rays.* **A. Righi.** (Accad. Lincei, Atti, 18. pp. 555–562, June 5, 1909.)—The effect of intensity of current, of pressure in the tube, and of diam. of kathode on the formation of magnetic rays has been determined, and the results plotted as curves. For currents up to 191×10^{-6} amp. there are two critical points in the curves, corresponding to the appearance and disappearance of magnetic rays. With increase of current these critical values also rise, gradually becoming closer together, until for currents of considerable intensity they coincide, and no magnetic rays are produced. The critical points are also brought closer together by increasing the pressure in the tube from 0·24 to 0·67 mm. Hg, or the diam. of the kathode disc from 4 to 7 mm. The most favourable conditions for formation of magnetic rays are a feeble current, a low pressure in the tube, and a small kathode. W. H. Si.

1433. *The Rôle of Impurities in the Photoelectric Effect on Liquids.* **E. Bloch.** (Comptes Rendus, 148. pp. 621–622, March 8, 1909.)—The author finds that ordinary water always shows the photoelectric effect of Hertz-Hallwachs. The effect is due to traces of surface impurities, probably of a fatty character. Only by extreme precautions is it possible to obtain water or an aqueous solution which is not photoelectric. D. H. J.

1434. *Conductivity of a Gas at Atmospheric Pressure under the Influence of a High-tension Alternating Current.* **A. Chassy.** (Comptes Rendus, 149. pp. 28–30, July 5, 1909.)—The apparatus used is a gas condenser formed of two concentric glass cylinders having the gas which is being studied between them. The armatures are fastened to the exterior of the large cylinder and to the interior of the small. The effect is studied in air and hydrogen. With the latter the results are regular, but in the case of air certain irregularities are found which are attributed to chemical reaction. For tensions below a certain value (here called "critical tension") which depends on the dimensions of the apparatus, the gas is not a conductor; it behaves like a perfect dielectric. The conductivity of the gas increases in a continuous manner with the tension, and it is not until tensions much higher than the "critical tension" are reached that the capacity of the gas condenser is the same as that which would be obtained by replacing the gas by a liquid conductor. The hypothesis is put forward that at that moment the gas is analogous to a conductor properly so called, and it is proposed to investigate whether under these conditions it obeys Ohm's law. A. E. G.

1435. *Initial Recombination of the Ions Produced in Gases by the α-particles.* **M. Moulin.** (Comptes Rendus, 148. pp. 1757–1759, June 28, 1909.)—Experiments have shown that in air it is easier to obtain the saturation current if the electric field is established perpendicular to the trajectories of the α-particles than if the field is parallel to the trajectories. This confirms the hypothesis of Langevin to explain the recombination of the ions liberated by the α-particles. The ions are not distributed uniformly through the whole volume of the gas, but initially are distributed along the trajectories of the α-particles. Thus an electric field normal to the trajectories will tend to disperse the ions and prevent their recombination much more than a field parallel to the trajectories. This hypothesis is confirmed entirely by the results of experiments on CO_2 and hydrogen. Since the speed of the α-particles is more than 1,000 times that of the molecules of the gas, it is probable that the α-particle which has just traversed the gas leaves behind it a column of ions the diam. of which is of the same order as the distance apart of the molecules, and is very small compared with its length. Thus a transverse field will have a greater effect in separating the ions than a longitudinal one; if the field is oblique, only the transverse component will add to the effect of diffusion. On passing the α-particles through a number of tubes the majority will leave at an angle to the axis of the tubes. A field established parallel to this axis will be practically oblique to the trajectories. Assuming that the current is obtained from the transverse component the author calculates the current that should be obtained, and finds that the saturation curve so obtained is in good agreement with that obtained by direct experiment. W. C. S. P.

1436. *Electrical Properties of Flames.* **V. Chiarini.** (Accad. Lincei, Atti, 18. pp. 503–507, May 16, 1909.)—The max. current obtainable from the flame of a Bunsen burner is produced when the burner itself is used as one electrode, a Pt wire held in the hottest part of the flame constituting the other. In this way an e.m.f. of 1 volt may be reached, and a current of 2 microamps. A gas flame is apparently able to separate two kinds of ions formed in it by combustion, or by dissociation of salts introduced into it. This power explains the existence of a current in the flame, its unilateral conductivity (which appears to be a characteristic of the flame itself rather than due to the current), and also the sensibility of a flame, in a closed circuit, to Herzian waves. It is further analogous to the separating power observed with certain forms of selenium [Abstract No. 884 (1909)], and the author concludes that in many respects a gas flame and a selenium-metal system are comparable with a vacuum tube. W. H. St.

1437. *Production of the Voltaic Arc.* **A. Occhialini.** (Accad. Lincei, Atti, 18. pp. 508–512, May 16, and pp. 589–595, June 5, 1909.)—Experiments on the cause of production of the voltaic arc show that the passage of a spark between the carbons is not sufficient *per se* to create an arc, nor does the arc result from ionisation of the air between the electrodes. The spark warms the negative electrode, and thus helps the formation of an arc, the negative ions leaving the kathode acting as a prolongation of the kathode. In its preparatory phase the voltaic arc is unaffected by a magnetic field which is sufficient to deflect it strongly when once definitely established, thus behaving similarly to an electric spark. W. H. St.

1438. *The Emission and Absorption of the Carbon Arc Light.* **M. Rosenmüller.** (Ann. d. Physik, 29. 2. pp. 355–397, May 21, 1909. Inaugural-Dissertation, Rostock, 1909.)—The question of the kind of radiation of the arc light, especially whether an essential portion of it consists of radiation of the same temperature, has hitherto been treated in a qualitative way, and but few attempts at quantitative measurements have been made. This scarcity of quantitative researches is chiefly due to the inconstancy of the arc radiation. When a quiet burning of the arc can be obtained there is a possibility of carrying out investigations on the absorption occurring and on the emission, taking into consideration the loss of light which occurs in the spectrometer. This investigation the author has undertaken, and describes in the present paper his methods and results. In the first part of the paper an account is given of the loss of intensity which takes place in the spectrometer, and in the second portion the determination of the absorption and emission of the principal bands of the spectrum is described. Sparks between zinc electrodes, mercury vapour lamps, and arc lamps were used as sources of light in the first part of the investigation. From the results obtained it appears that the chief emission of the arc occurs at the band 385 $\mu\mu$, which agrees with Snow's observations, yet the estimated emission given by him relative to band 357 $\mu\mu$ scarcely takes place on account of the strong absorption here occurring in the optical glass of the spectrometer. The results summarised in the tables indicate further that regions of strong emission coincide with regions of strong absorption, and, moreover, that for such light as is not markedly emitted by the arc the absorption lies within the limits of error. Hence it follows that the views expressed by Mrs. Ayrton with regard to the absorption in the arc are not conclusive, namely, that the arc absorbs green and yellow selectively and thus appears the more violet the longer it exists, because the radiation proceeding from the crater is changed in its composition, the violet remaining in excess. Investigation showed that, contrary to the assumption of Mrs. Ayrton, greater selective absorption in the yellow and in the green does not take place. The researches indicate that a considerable proportion of the existing radiation of the arc is temperature radiation. In some further experiments on the photoelectric action of the arc it was found that the strong bands 385 and 357, notwithstanding their great energy, show only an insignificant photoelectric action. The part of the spectrum which exhibits the photoelectric effect is that between 251 and 221. In the extreme ultra-violet the carbon arc possesses only one intensive band, that at 221. These observations agree with those made by Ladenburg. J. J. S.

1439. *Effect of an Air-blast upon the Spark Discharge in Condenser Circuits.* **J. A. Fleming** and **H. W. Richardson.** (Phil. Mag. 17. pp. 677–692, May, 1909. Paper read before the Physical Soc., March 26, 1909. Electrician, 63. pp. 175–176, May 14; Discussion, p. 26, April 16, 1909. Abstract.)—The authors show from their experimental results that, when using spark-gaps 1 to 8 mm. in length, it is advantageous to apply an air-blast to the gap. The mean-square value of the current is thereby increased, and owing to the resulting steadiness of the discharge, a very much more accurate reading of the current is obtained. The mean-square current is also increased by subdividing the gap (for gaps up to 8 mm.), which also suppresses the arc discharge, but the same steadiness is not obtained. The primary decrement and the spark-resistance are but little affected by the air-blast. L. H. W.

1440. *Production of Alternating Currents by means of a Continuous-Current Arc.* **K. W. Wagner.** (Elektrotechn. Zeitschr. 30. pp. 603–607, July 1, and pp. 627–632, July 8, 1909.)—The first paper gives a full discussion of the theory of the production of alternating currents by the direct-current arc. It is a *résumé* of work already published. The second paper deals particularly with that kind of oscillatory current—called by Simon oscillation of the "second kind"—in which the arc is quenched by the discharge of the condenser but not made again in the opposite direction. There are thus three periods of time to consider—T the natural period of oscillation of the condenser circuit, T_1 the period during which the arc burns, T_2 the period during which it is quenched. It is shown theoretically that (1)—

$$T_2/T = E_e/\pi i_e\rho,$$

and (2)—

$$T_1/T = \tfrac{1}{2} + 1/\pi \,.\, \tan^{-1}(i_e\rho/E_e),$$

where E_e = excess of p.d. required to strike the arc over the p.d. required to keep it burning, i_e = current taken from dynamo, which is supposed to be kept constant, and $\rho = \sqrt{L/C}$. Thus if T and E_e are kept constant, everything depends on ρ and i_e, neither of which must pass beyond or below certain values, if oscillations of the "second kind" are to be produced. The author then describes some experiments now in progress. His arc burns between water-cooled *metal* electrodes. The continuous-current dynamo maintains a voltage of 5,500 volts. The resistance in the dynamo circuit exceeds 2,000 ohms. He finds that the material of the kathode of the arc plays a great part in determining whether the arc is to be active or not. The anode has no influence, provided it be of metal. By far the best results are obtained with Al electrodes. With these, without any magnetic field or hydrogen atmosphere, he reaches frequencies of oscillation far in excess of any yet obtained with the arc. He obtains oscillations in wires 1 m. long attached to the electrodes. His highest frequency corresponds to a wave-length of about 1 m. It is to be noted that the ammeter in the condenser circuit always shows a minimum deflection at the transition from damped to undamped oscillations. T. P. B.

1441. *Effect of Temperature on Damping in Glass Condensers.* **J. J. Stöckly.** (Schweiz. Elektrot. Zeit. 6. pp. 309–312, June 26, 1909. Lumière Électr. 7. pp. 57–60, July 10, and pp. 91–93, July 17, 1909.)—The method employed is as follows : Two circuits—the one containing the condenser under examination, the other containing an air condenser and a variable inductionless resistance—are brought into resonance with an oscillating circuit. Both circuits contain the same variable self-inductance and hot-wire indicator. Although all else is the same, the deflections of the indicator at resonance are not the same for the two circuits, owing to damping in the glass condenser. They are made equal by inserting a certain amount of the variable inductionless resistance in the second circuit, and from this resistance the logarithmic decrement due to the glass condenser is calculated. Preliminary experiments show (1) that there is no change in the decrement and in the capacity of the glass condenser as the wave-length is altered from 550 to 1,800 m. ; (2) that the capacity increases by about 4 per cent. as the temperature rises from 20° to 70° C. It is then shown that the decrement due to the glass condenser increases (from 0·0168 at 0° C.), at first slowly, and then more and more rapidly (to 0·05 at 80° C.). By the ammeter and voltmeter method it is shown that the conductivity of the glass has very little to do with this change. It is therefore to be ascribed to the so-called dielectric hysteresis. T. P. B.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1442. *The Measurement of Capacity and Inductance.* **Decoin and Devaux-Charbonnel.** (Électricien, 38. pp. 19–23, July 10, 1909.)—The principle of the method is well known. Let us suppose that a capacity K is charged by means of a battery E and is discharged through a dead-beat galvanometer *n* times per sec. The quantity of electricity passing through the galvanometer per sec. is *n*KE, and this will produce on the galvanometer exactly the same deflection as a constant current I, where I = *n*KE. We also have I = E/R, and thus K = I/*n*R. Hence the capacity K is given in terms of *n* and R only. To utilise this formula it is necessary to have apparatus which will discharge the condenser *n* times per sec. through the galvanometer, and *n* must be capable of being measured with high precision. The authors use a special type of electrical tuning-fork for this purpose in which the vibrations are recorded on a rotating drum. A Sullivan galvanometer is employed which has no "zero creep," and the sensitivity of which remains absolutely constant. The experimental results given prove that the accuracy of the method is about 1 in 10,000. With air condensers the values found for the capacity are always the same, but for mica condensers the capacity diminishes as the frequency increases; the specific inductive capacity of mica and of many other insulating materials diminishes as the frequency increases. The method enables us to measure accurately capacities as small as the hundred-thousandth of 1 mfd. Knowing accurately the capacity of a condenser it is very easy to measure self-inductance. A capacity K shunted by a resistance R is equivalent to a negative self-inductance $-KR^2/(1+\omega^2K^2R^2)$, where $\omega=2\pi f$ and f is the frequency. A telephone bridge can thus be used to obtain a balance. Inductances as small as the millionth of a henry can be measured in this way. With this apparatus inductance and capacity can easily be measured accurately by any electrician. A. R.

1443. *Temperature Distribution in Tubular Electric Furnaces.* **A. Rothenberger.** (Zeitschr. Instrumentenk., Beib. 11. pp. 101–104, June 1, 1909.)—The author experiments on furnace tubes of Jena glass, 25 and 50 cm. in length, wound with nickel wire. The temperature was not raised above 800° C. In the vertically arranged tube the temperature in the middle section varied by 12·5°, in the horizontally placed tube by 2·5°; the ends of the tube were always much cooler than the middle. These fluctuations could partly be cured by pushing a cylinder of very thin copper foil into the furnace, lying close against the wall of the tube, and longer than the object to be heated, but not projecting by more than a few cm. beyond its ends. The experiments were made in connection with calorimetric researches. H. B.

1444. *Automatic Regulation of an Electric Furnace.* **L. Kolowrat.** (Journ. de Physique, 8. pp. 495–497, July, 1909.)—Describes a method designed for the automatic regulation of an experimental electric furnace of the resistance type when it is desired to keep the temperature as constant as possible for several days. The method makes use of a thermo-couple placed in the furnace and connected with a galvanometer; mirrors are so arranged that the rays from a Nernst lamp are deflected on to a scale showing the temperature required, and this scale is placed in such a position that a slight elevation of temperature above that desired causes the image of the lamp to be focussed on the junctions of a thermopile of 20 copper-constantan elements. The current thus produced acts on a system of three relays which act consecutively, and by this means a resistance is introduced into the furnace circuit which lowers its temperature; the deflection of the galvanometer is thus diminished, the image of the lamp leaves the thermopile, and the system of relays cuts out the resistance. By this means it is possible to keep the temperature constant to 2° or 8° at about 1,000°. C. O. B.

1445. *Alternating-current Galvanometer.* **Guinchant.** (Comptes Rendus, 148. pp. 1674–1675, June 21, 1909.)—The measurement of resistances by Kohlrausch's method becomes in certain cases practically impossible when one of the arms of the bridge introduces a lag of current. An inductive coil, an electrolyte, or a shunted condenser, although insufficient to produce a sensible phase-difference, yet produces a parasitic sound which takes away all the precision of the method. The author replaces the telephone by the following galvanometer: A strip of iron suspended by a silk fibre is placed at the common junction of the axes of two coils, and the coils are adjusted so that their axes are perpendicular. The thick wire coil carries a constant alternating current, the other coil replaces the telephone. The first coil is placed at right angles to the magnetic meridian, and consequently at right angles to the strip when controlled by the earth's magnetic field. The earth's field is practically neutralised by an external magnet, and so the strip is controlled by the alternating field. A null deflection is obtained when there is a balance and the apparent resistance is determined. The galvanometer works equally well with direct current. A. R.

ALTERNATING CURRENTS AND MAGNETISM.

1446. *Reversible Permeability of Iron.* **R. Gans.** (Ann. d. Physik, 29. 2. pp. 301-315, May 21, 1909. Physikal. Inst., Tübingen, March 21, 1909.)—The paper is a further contribution [see Abstract No. 1845 (1908)] on reversible permeability. In the first section curves are given showing the variation of reversible longitudinal permeability with intensity of magnetisation in the case of Remy steel and soft iron, and the conclusion is drawn that the reversible longitudinal permeability is a universal function of the intensity of magnetisation containing two parameters characteristic of the given material. In the second section are given curves showing the variation of the reversible *transverse* permeability, that is, the ratio dB/dH, where dH is a small change in the magnetising force perpendicular in direction to the original magnetisation. The curves show that, whereas the longitudinal reversible permeability diminishes with increase of magnetisation in a manner similar to that of the ordinary permeability, the reversible transverse permeability increases very gradually for a considerable range of magnetisation (0-1000) before beginning to diminish. For zero initial magnetisation the two permeabilities should be alike, but the test results gave them slightly different values, which the author attributes to the fact that the specimens used in the two cases, although of the same iron, were probably of different magnetic quality. From the results the conclusion is drawn that a ferromagnetic body having initial magnetisation is magnetically anisotropic to small superimposed magnetic fields, and, in fact, has the properties of a uniaxial crystal, the axis of which corresponds with the direction of initial magnetisation. The two remaining sections are devoted to a theoretical consideration of this magnetic anisotropism, and to a further criticism of the Cisotti Theory of Hysteresis.

J. D. C.

1447. *Magnetic Changes in Lead.* **Loutchinsky.** (Comptes Rendus, 148. pp. 1759-1760, June 28, 1909.)—The author has observed that the crystallisation of lead leads to remarkable changes in its mechanical and magnetic properties. Thus at the surface of flowing ingots of small thickness it is possible to observe the formation of crystals of lead which can be isolated, near the point of fusion, by crushing with a glass rod. It is also found that the magnetic susceptibility is, for lead crystallised by fusion, ten times greater than for that mechanically deformed by hammering. Other bodies observed, such as pure zinc and tin, show no magnetic change on fusion; on the other hand, $Zn_{10}Fe$, which in the natural state is not magnetic, becomes strongly magnetic after fusion, being partially decomposed, with separation of iron. W. C. S. P.

1448. *Magnetic Properties of a Pure Specimen of Soft Norway Iron.* **B. O. Peirce.** (Amer. Journ. Sci. 28. pp. 1-8, July, 1909.)—The author was led to investigate a sample of the very best brand of soft Norway iron, owing to the fact that a special electromagnet constructed with the iron had given such poor results. A rod 1·26 cm. in diam. and 8 cm. long was tested in a massive yoke, the ends being tapered down so as to fit into conical jaws. The value of H in the air near the region of the centre of the rod was found to be sensibly equal to the value in rod. With the aid of a couple of test-coils corresponding values of H and B were determined, using a special galvanometer of very long period. The max. value of I was found to be 1,788, and for large excitations $B = H + 21{,}780$. The results show that the magnetic permeability is extraordinarily high under strong excitation, having a value 11·89 for $H = 2{,}000$. Thus the failure of the above-mentioned magnet could not be ascribed to poor material; it was subsequently found to be due to the presence of ten consequent poles when excited. A second piece of Norway iron, tested as a long rod when placed in a solenoid, was found to undergo a sensible increase in permeability at low inductions after being elaborately annealed. Other specimens of Norway iron were tested by the yoke method and by the isthmus method. The observed values of the max. value of I do not differ in the former method by more than ¼ of 1 per cent. from the mean; the isthmus method, however, does not appear to give such good results.

W. C. S. P.

1449. *Hall Phenomenon in Liquids.* **G. Delvalez.** (Journ. de Physique, 8. pp. 360–370, May, 1909.)—In 1896 Bagard published results of certain experiments which indicated that the phenomenon of Hall existed to a high degree in liquids. The results given by Bagard have been tested by the present author, who made use of the figures of Nobili, which are formed by lines of equal density of current. If such figures are produced in a magnetic field normal to the lines of flux their form should be modified. Various experiments are described, but the changes which occur appear to be due to movement of the electrolyte, and the existence of the Hall-effect in liquids cannot be proved in this way. The author suspects the inexactitude of Bagard's results, and considers that the currents in the liquid led to the production of an apparent Hall-effect, whilst a true Hall phenomenon has not yet been proved to exist in the case of liquid conductors. J. J. S.

1450. *Induced Earth Currents in Polar Regions.* **K. Birkeland.** (Comptes Rendus, 148. pp. 1556–1559, June 7, 1909.)—By means of two short cables, directed N–S and E–W, at Kaafjord, in Finmark, the earth currents have been registered for certain periods during magnetic storms. Very definite indication was found between variations of these currents and oscillations of the magnetic declination, suggesting that the phenomena are due to induced currents. C. P. B.

REFERENCES.

1451. *Electromagnetic Theory of Moving Bodies.* **A. Einstein** and **J. Laub.** (Ann. d. Physik, 28. 2. pp. 445–447, Feb. 4, 1909.)—Gives some corrections to the work dealt with in Abstract No. 1991 (1908).

1452. *Treatment of Electrodynamics.* **S. G. Starling.** (Phil. Mag. 17. p. 767, May, 1909.)—Following the proposals of Lehfeldt [Abstract No. 663 (1909)], the author gives a simple proof of the formula $B = H + 4\pi I$, and of the formula for the work done in taking a specimen through a hysteresis cycle $W = HdI$. The proofs are based on first principles, and are independent of any assumption as to the nature of the ultimate magnetic particle. E. E. F.

1453. *Attempts to Explain the Phenomenon of Globular Lightning.* **C. De Jans.** (Soc. Belge Élect., Bull. 26. pp. 123–168, March, 1909.)—A discussion supplemented by full bibliographic references.

1454. *Action of Ultra-violet Light on False Equilibria.* **H. Buisson.** (Journ. de Physique, 7. pp. 952–955, Dec., 1908.)—An adverse criticism of Mme. H. Baudeuf's paper [Mém. de la Société des Sciences physiques et naturelles de Bordeaux, t. iv., 6th Série, 1908, and Abstract No. 886 (1909)] on the action of light on false electric equilibria. **H. Baudeuf.** (Ibid. pp. 955–957, Dec., 1908.)—Mme. Baudeuf's rejoinder to H. Buisson. D. H. J.

1455. *Graduated Self-induction Standards.* **Kollert.** (Elektrotechn. Zeitschr. 30. pp. 560–561, June 17, 1909.)—After some general remarks as to the determination of coefficients of self-induction by means of graduated standards and a discussion of the earlier constructions, two types of graduated standards are described, one having a range of 1 to 0·001 henry by using a plug board, and the other having a range from 5·6 to 0·58 henry. F. E. S.

1456. *Mayer's Floating Magnets.* **L. Derr.** (Amer. Acad., Proc. 44. No. 19. pp. 525–528, May, 1909. Contribution from the Rogers Laborat. of Physics, Massachusetts Inst. of Technology.)—A photographic study of the above, showing all the stable configurations of 1 to 52 bar magnets. A table is also given of the calculated configurations. The balls were of ¼-in. steel floating on clean mercury. G. E. A.

1457. *Comparisons of Magnetic Standards.* **J. A. Fleming** and **J. C. Pearson.** (Terrestrial Magnetism, 14. pp. 8–16, March, 1909. Paper read before the Amer. Assoc. for the Advancement of Science, Dec. 31, 1908.)—In connection with the general magnetic survey of the globe undertaken by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, comparisons of the standard instruments employed are made whenever possible with the base instruments at other observatories. The present paper deals with the comparison determinations made during 1908. C. P. B.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1458. *New Form of Platinum-resistance Thermometer: Molecular Weight Determinations in Fused Potassium Nitrate.* **J. G. L. Stern.** (Zeitschr. Phys. Chem. 65. 6. pp. 667–694, March 16, 1909. Extract of Dissertation.)—The author describes a new form of Pt-resistance thermometer which permits of the measurement of small differences of temperature at about 300°. Values constant to within 0·04° have been obtained for the freezing-point of potassium nitrate. The values of the molecular depression of the freezing-point of potassium nitrate by various salts have been determined, the results being as follows: KNO_3, 7·5; KCl, 14; $NaNO_3$, 15; $AgNO_3$, 18·5; $Sr(NO_3)_2$, 20; $Ba(NO_3)_2$, 20; $SrCl_2$, 43; $BaCl_2$, 48; K_2SO_4, 52; Na_2SO_4, 56. The value of the constant, calculated by means of van't Hoff's formula, is about 16, so that potassium nitrate is bimolecular, potassium chloride unimolecular, the nitrates of sodium, silver, barium, and strontium slightly ionised, whilst sodium chloride is split up into two parts, barium and strontium chlorides into three parts, and sodium and potassium sulphates into more than three parts. T. H. P.

1459. *A Graphite Kathode Dish.* **J. W. Turrentine.** (Journ. Phys. Chem. 13. pp. 438–448, June, 1909.)—With a view to replacing platinum electrodes in electrochemical experiments by a cheaper material the author has carried out a number of preliminary experiments with dishes made of Acheson graphite. Fairly satisfactory results were obtained when the dish was used as the kathode in a copper voltameter, but further experiments are necessary to find out the best means of drying the metallic deposits, &c. The author is consequently continuing and extending his investigations. T. S. P.

1460. *Apparatus for Research on Electrical Transport in Organic Colloids.* **F. Bottazzi.** (Accad. Lincei, Atti, 18. pp. 485–489, May 16, 1909.)—An apparatus is described which allows of quantitative measurements with very small quantities of colloidal solutions. It consists of a U-tube, about 1 cm. in diam., and having in the middle of each arm a tap, which when open does not cause any constriction in the tube. The colloidal solution is introduced into the tube up to the taps, which are then closed, the upper parts of the arms rinsed with distilled water, and filled with distilled water exactly to the same level in each. Two Pt electrodes are then placed in the upper branches of the tube, the p.d. being 110 to 220 volts, and the taps opened. The current is made to pass through a milliammeter, and should not exceed 0·0001 amp., with a fall of potential of about 5 volts per cm. After passing the current for 12, 24, or 48 hours it is interrupted, the taps closed, and the liquids surrounding the electrodes examined separately. The liquid in the lower part of the tube can also be recovered and examined. Another form of apparatus is described for the qualitative examination of larger quantities of liquid. Three beakers are placed side by side, the two outer ones filled with distilled water, and the middle one with the colloidal solution. The contents of the outside beakers are in each case connected with the central solution by means of inverted U-tubes filled with distilled water. The electrodes are placed in the beakers containing the water and a current passed, the fall of potential being again about 5 volts per cm. In dialysis of organic liquids liable to putrefaction the author recommends saturating the water with chloroform, and also adding chloroform to the solution. Toluol also arrests putrefaction. W. H. Si.

1461. *Metallic Beryllium (Glucinum) by Aluminium Thermit.* (D.R.-P. 208,402. Metallurgie, 6. p. 421, July 8, 1909. Abstract.)—G. Just and M. Mayer obtain glucinum as a solid metal from its oxide and powdered Al by supplying sufficient heat not only to start the reaction, but to maintain the temperature above 1,430° C., the melting-point of the glucinum. Otherwise the metal is obtained as a spongy mass mixed with alumina. H. B.

1462. *Compounds of Boron with Metals.* **A. B. du Jassonneix.** (Annal. Chim. Phys. 17. pp. 145–216, June, 1909.)—Alloys of iron with up to 28 per cent. B can be prepared, and the two compounds Fe_2B and Moissan's FeB were recognised. The existence of FeB_2 is probable. Attempts to add more B than 28 per cent. only resulted in forming carbon boride. Co_2B and Ni_2B were isolated, CoB and NiB verified; and CoB_2 and NiB_2 probably exist. Up to 28·6 per cent. B was added to Mn. The compound MnB is magnetic; and MnB_2, found when B exceeds 20 per cent., is non-magnetic. As much as 26·7 per cent. B was added to Cr, and the compounds Cr_3B_2 and CrB were isolated, and their existence was confirmed metallographically. CrB is formed by the action of boron chloride on chromium at 1,100°. Hard alloys of B and Mo were made; with 45 per cent. B alloyed with Mo the alloy dissolved 16 per cent. of carbon boride. Deville's "graphitoidal boron" is AlB_2, and his "adamantine boron" is made by heating the hexagonal plates of AlB_2 with excess of B, when octahedral crystals are obtained. Prolonged heating of B, Al, and C in the arc furnace gave crystals which are probably a solid solution of AlB_2 and Al_4C_3. Thorium gives two compounds with boron: ThB_4 and ThB_6. Up to 4·5 per cent. B was dissolved in Pt, and the alloys were decomposed by adding a metal with which Pt will alloy. B is insoluble in the borides made, and in copper, silver, and tin. F. R.

1463. *Formation of Alloys by Pressure.* **G. Masing.** (Zeitschr. Anorg. Chem. 62. 4. pp. 265–309, June 17, 1909. Communication from the Inst. f. Physikal. Chem. d. Univ., Göttingen.)—The author studied the formation of alloys by compressing mixed powders of metals, by microstructural effects of heating, heating curves, and electrical conductivity. No solid solutions and no compounds are formed in the following pairs by compressing: Zn-Cd, Ag-Cu, Bi-Tl, Sn-Cu, Zn-Cu (by microstructure), and Pb-Tl (by conductivity); the only effect of the pressure is to bring the grains of metal into close contact. With lapse of time or increase of temperature the formation of compounds [pairs: Mg-Pb, Mg-Sn, Mg-Zn, Mg-Sb] or of solid solutions [pairs: Bi-Tl, Pb-Tl] slowly proceeds; and in some cases if the heating be sufficiently prolonged, without approaching melting temperatures, the equilibrium condition of the system is closely approximated to. The heating curves of the compressed mixtures depend upon the rate of heating, and are irreversible. When the series forms neither compounds nor solid solutions the heating curve differs but little from that of the corresponding alloy made by fusion. When compounds, but not solid solutions, occur, a slight retardation is obtained at the temperature of the lowest non-variant system: component—compound—melt, proving that the compound had formed in the solid state. If no compound had formed, an unstable eutectic point would be observed at a lower temperature, corresponding to the system: both components and their mutually saturated melts; this point was not found in any instance. At higher temperatures jumps occur in the curves, corresponding to explosive reactions between the metals. In the case of metals which form solid solutions there is evidence that diffusion proceeds in the solid state, and the heating curve approaches more nearly to that of the fused alloy the more slowly the compressed sample has been heated. [See also G. Tammann, Zeitschr. Elektrochem. 15. pp. 447–450, July 1, 1909.] F. R.

1464. *Nature of Lead-Palladium Alloys.* **N. A. Puschin** and **N. P. Paschsky.** (Zeitschr. Anorg. Chem. 62, 4. pp. 360–368, June 17, 1909. From the Ber. d. St. Petersburger Polytechn. Inst., IX.)—The electrical potentials acquired by the alloys against pure lead electrodes have been determined in an electrolyte of $n\mathrm{PbNO}_3$. On account of the fact that in the alloys containing over 33 atoms per cent. Pd the potentials only gradually assumed constant values, measurements were taken over several hours, *e.g.*, the element $\mathrm{Pb}[n\mathrm{PbNO}_3]\mathrm{Pd}$ showed an e.m.f. of 760 millivolts immediately after preparation, 330 after 2 hours, and after 3 hours the value gradually fell to 600 millivolts, which agrees with the constant value obtained for all alloys containing over 33 atoms per cent. Pd. Up to 33 atoms per cent. Pd the alloys showed potentials not exceeding 2 millivolts. Here a marked discontinuity appears in the concentration-potential curve, the value for e.m.f. suddenly rising to 600 millivolts. This conclusively proves the existence of the compound $\mathrm{Pb}_2\mathrm{Pd}$. F. C. A. H. L.

1465. *Variation in Structure of Italian Silver Coinage during Manufacture.* **E. Pannain.** (Accad. Lincei, Atti, 18. pp. 523–525, May 16, 1909.)—The metal contains 83·29 per cent. Ag and 16·58 per cent. Cu, and is cast into bars 40 cm. long, 7–8 mm. thick, and from 3·5 to 5·5 cm. in width according to the diam. of the coin to be made from it. The bars are first rolled, then raised to incipient redness for about half an hour, allowed to cool slowly in air, and again rolled seven or eight times until reduced to a thickness of about 2 mm. The heating, cooling, and rolling are then repeated until the thickness is only about 1 mm. The desired impression is now made on the coin, which is afterwards washed with dilute sulphuric acid, to remove all traces of copper oxide, rinsed with water, and dried in the oven at 200–300°. Seven specimens taken at different stages of the treatment have been polished and examined microscopically, showing that at each point the metal has a definite structure. The effect of rolling is always to lengthen the white crystals, which tend to appear as parallel fibres, while heating gives the structure a more regular appearance. It is thus possible to decide from the microscopical appearance whether an alloy has been obtained by fusion or mechanically worked, and the application of the method to the detection of counterfeit coins is pointed out. [See also Abstract No. 567 (1909).] W. H. Si.

1466. *Chemical Reactions in Gaseous Mixtures at High Pressures.* **E. Briner** and **A. Wroczynski.** (Comptes Rendus, 148. pp. 1518–1519, June 7, 1909. Zeitschr. Anorg. Chem. 63. 1. pp. 49–52, June 30, 1909.)—By condensing a gaseous mixture in a thick-walled tube by means of liquid air, sealing the tube and then warming to the ordinary temperature, the authors are enabled to study the reactions between gases at pressures exceeding 500 atmos. Under these conditions nitric oxide and hydrogen chloride react according to the equation $2\mathrm{NO} + 2\mathrm{HCl} = \mathrm{NOCl} + \mathrm{H}_2\mathrm{O} + \mathrm{Cl} + \mathrm{N}$ and nitric oxide and sulphur dioxide according to $\mathrm{NO} + \mathrm{SO}_2 = \mathrm{SO}_3 + \mathrm{N}$. T. H. P.

osmotic pressure of a solution in terms of its own physical properties, without making any assumptions in reference to the separate properties of the constituents of the liquid and without even postulating the separate existence of the two constituents, one of which, for instance, might be a hydrate incapable of being isolated. The question of the concentration of a solution by centrifugal force is also discussed, and preliminary experiments with aqueous sugar solutions are described. The important mathematical investigations cannot be adequately dealt with in an abstract, and should be referred to in the original paper. T. M. L.

1472. *Relations between the Velocity of Chemical Reactions and the Velocity of their Part Reactions.* **G. Just** and **W. Berezowsky.** (Zeitschr. Elektrochem. 15. pp. 297–305, May 15, 1909. Inst. f. physikal. Chemie u. Elektrochemie, Karlsruhe, March, 1909.)—The reaction considered is that between potassium iodide and potassium ferricyanide, which can be divided into the two reactions $I' + \oplus \rightleftarrows I$ and $FeCy_6''' + \ominus \rightleftarrows FeCy_6''''$. That the whole reaction is measurable leads one to suppose that one of these part reactions at least must be slow. That this is the case in the first part reaction is not likely, since the iodine electrode has been shown to be non-polarisable. It is probably therefore the second reaction that gives the character to the reaction velocity. The author has therefore studied the polarisation of alkaline solutions of potassium ferro- and ferricyanide, and finds that anodic and kathodic polarisation is feeblest in the case of Pt, rather greater in the case of Au, and greatest of all in the case of Cr. In the case of Au and Pt, one could distinguish two different surface conditions, one feebly polarisable (evidently due to oxidation) and the other strongly polarisable (when previously subjected to reducing agents). It was also found that the power of the above metals of catalytically accelerating the reaction between potassium ferricyanide and potassium iodide runs parallel with their polarisability in mixtures of potassium ferro- and ferricyanide. A. F.

1473. *New Method of Measuring the Partial Vapour Pressure of Binary Mixtures.* **M. A. Rosanoff, A. B. Lamb,** and **F. E. Breithut.** (Amer. Chem. Soc., Journ. 31. pp. 448–456, April, 1909.)—The method consists in boiling a liquid mixture the composition of which is kept substantially constant by adding the more volatile constituent at such a rate that the mixture boils at a constant temperature: the vapour is bubbled through an inner "equilibrium chamber" containing a small quantity of mixed liquid the composition and temperature of which soon become steady within extremely narrow limits; this liquid is analysed, and the vapour which has passed through it is also condensed and analysed. The results obtained appear to be remarkably accurate: A mixture of CCl_4 and $C_6H_5 . CH_3$ gave an equilibrium-temperature which was kept constant without difficulty within 0·02° C.: the liquid in the chamber contained 55·26 per cent. CCl_4, successive portions of the condensed vapour contained 79·28, 79·26, and 79·28 per cent. CCl_4. Again in the case of CS_2 and CCl_4 the temperature readings on a Beckmann thermometer were 1·72, 1·72, 1·72, 1·71, and 1·71, and the refractive indices of the distillate were 89° 40′, 89° 41′; 89° 41′, 89° 41′; 89° 40′ and 89° 40′, the successive pairs of observations being made after the equilibrium had been disturbed and restored. T. M. L.

1474. *Critical Temperature of an Associated Liquid from Surface Tension Measurements.* **J. L. R. Morgan.** (Amer. Chem. Soc., Journ. 31. pp. 309–

822, March, 1909. Contribution from the Havemeyer Lab. of Columbia Univ., No. 160.)—Over a considerable range of temperature the molecular surface tension of an associated liquid can be expressed by the equation—

$$\gamma(M/d)_t^{2/3} = \gamma(M/d)_0^{2/3} - k_0 t - \tfrac{1}{2} dk/dt \, . \, t^2,$$

two sets of coefficients being needed as a rule for specially high and for specially low temperatures. If the equation shows a good agreement, the critical temperature can be found by making $\gamma(M/d)_t^{2/3} = 0$ and solving for t, which gives a point 6° below the critical temperature. If accurate data are available only for low temperatures, the first differential equation—

$$k_t = k_0 + dk/dt \, . \, t$$

can be solved so as to give the critical temperature, since at this point $k = 0$ and therefore $t_c = k_0/(dk/dt) + 6$. The above formulæ have been found to give good results when used to calculate the critical temperatures of water, methyl and ethyl alcohols and acetic acid from the surface-tension data of Ramsay and Shields. T. M. L.

1475. *Relationship between the Capillarity-constants and the Latent Heats of Vaporisation of Solvents.* **P. Walden.** (Zeitschr. Phys. Chem. 65. 3. pp. 257–288, Jan. 5, 1909. Phys. Chem. Laborat. des Polytechnikums, Riga.)—A simple relation exists between the latent heat of vaporisation λ and the specific cohesion a^2, namely, that at the normal boiling-point of a non-associated liquid $\lambda/a^2 = 17{\cdot}9$, whilst associated liquids give higher values: the relationship can be used to calculate latent heats, even when the capillarity constants are only known at temperatures below the boiling-point; by using van't Hoff's equation, the molecular elevation of the boiling-point can also be calculated from the same data. The molecular cohesion Ma^2, the molecular heat of vaporisation $M\lambda$, and the boiling-point T in absolute degrees possess an additive character and are influenced very largely by the total number of valencies in the molecule. The conclusion is drawn from the constancy of the ratio λ/a^2 that the molecules of non-associated liquids have approximately the same diameter. T. M. L.

1476. *Dissociation of Carbonic Acid in the Carbon Monoxide-Oxygen Gas Flame.* **F. Haber** and **R. Le Rossignol.** (Zeitschr. Phys. Chem. 66. 2. pp. 181–196, March 30, 1909. From the Inst. f. physikal. Chemie u. Elektrochemie d. techn. Hochschule, Karlsruhe.)—The authors have reinvestigated the dissociation of carbonic acid by withdrawing the gases from the flame of burning CO. In this way the equilibrium constant of the reaction $CO_2 \rightleftarrows CO + O$ is determined. From this and the heats of combustion and specific heat the temperature can be calculated. As a result the authors have found that the equilibrium constant $K_p = p_{CO_2}/p_{CO} \times p_{O_2}^{1/2} =$ about 4, corresponding with a dissociation of about 37 per cent. The corresponding temperature was calculated to be a little over 2,600° C. A. F.

1477. *Liquid Chains of Aqueous Solutions of Electrolytes having a Common Ion.* **M. Chanoz.** (Comptes Rendus, 148. pp. 618–621, March 8, 1909.)—A study of liquid chains of the type $\mathrm{MR} \underset{[1]}{|} \mathrm{M'R'} \underset{[2]}{|} \mathrm{MR}$; the passage of the current causes inverse changes in the concentrations at the points of contact [1] and [2], as is easily seen when coloured substances are used for M′R′. If the anion is the common ion, M′R′ becomes more concentrated at the point of exit of the current; if the kathion is the same for the two electrolytes, the increased concentration is at the point of entry of the current. D. H. J.

1478. *Galvanic Cells with Solid Electrolytes.* **R. Beutner.** (Zeitschr. Elektrochem. 15. pp. 488–489, July 1, 1909. Extract of Dissertation, Karlsruhe, 1908.)—The author gives particulars of his experiments [see Abstract No. 678 (1909)] which he conducted with F. Haber, to whom he refers as to the theory [see Abstract No. 1788 (1908)]. The data demonstrate in particular that the e.m.f. becomes zero when the salts are grouped for that purpose, and that intermediate salts which do not take part in the reaction may be interposed between the other salts. Salts in contact must always have an ion in common, lest the cell be not reversible, and all the salts which have an ion in common, except the terminal salts, are intermediate in the sense indicated. The e.m.f.'s observed frequently agree much better with Thomsen, or with Petersen and Guntz than with Berthelot. It results that forces are set up on the boundary (solid)/(liquid) which are dependent upon the concentration of the ions in the liquid phase in the same way as they are near electrodes, and that these forces are thus in accordance with Nernst's theory. H. B.

1479. *Apparent Increase in Electrolytic Conductivity along Lines of Magnetic Flux.* **C. J. Reed.** (Electrochem. Ind., N.Y. 7. p. 316, July, 1909.)—An accident to a submerged magnetic separator caused a peculiar corrosion in the copper tube surrounding the magnet. The peculiar locus of corrosive action showed that the line of least resistance to the electrolytic current was along the lines of most intense magnetic flux, and that, therefore, there was an increased electrolytic conductivity along these lines. Photographs of the copper tube and other details are given. T. S. P.

1480. *Anhydrous Hydrazoic Acid.* I. *Electrolysis of a Solution of Potassium Azide in Hydrazoic Acid.* **A. W. Browne and G. E. F. Lundell.** (Amer. Chem. Soc., Journ. 31. pp. 435–448, April, 1909.)—Hydrazoic acid, N_3H, when pure and anhydrous, offers, like hydrazine and ammonia, a very high resistance to the electric current, but the conductivity is very greatly increased by the addition of potassium azide, N_3K. The ratio of hydrogen and nitrogen liberated by electrolysis is $3N_2 : H_2$, but a lower ratio is obtained under certain conditions. Appreciable amounts of ammonia are obtained during the electrolysis, but no hydrazine; the formation of these compounds would raise the ratio of nitrogen to hydrogen, so that the lower ratio must be explained in some other way. After electrolysis at −80° C. the acid is very sensitive to shock; this might be due to the production of ozone if the presence of moisture be assumed, but alternatively it is suggested that a polymeric form of nitrogen (N_3), may be formed, thus accounting for the low ratio of nitrogen to hydrogen, as well as for the explosibility of the acid.

T. M. L.

REFERENCE.

1481. *Logic of the First Law of Thermodynamics.* **J. E. Trevor.** (Journ. Phys. Chem. 13. pp. 355–382, May, 1909.)—An outline treatment of the first law of thermodynamics. A. F.